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Personal Computer Programs for the Control of Subnanosecond Transient Digitizers with Applications for Device Damage Testing

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Electronic or electromagnetic events with subnanosecond rise times can be recorded by two transient digitizers controlled by a personal computer through the General Purpose Interface Bus (GPIB). The subnanosecond capability is dependent on the digitizer configuration, specifically the vertical amplifier plug-in for the digitizer. The programs described in this manual, which were written as part of the Harry Diamond Laboratories EMP Hardening Technology Program, make direct provisions for device damage testing. While this testing requires slower rise-time plug-ins, the programs can be used for digitizers in the faster rise-time configuration. These programs are easily modified for other applications. In addition to controlling and operating the digitizers, the programs provide for the presentation, storage, retrieval, and recordkeeping of the data files. The digitizers are not applicable to testing when data records longer than 10 ms are required.

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1. Introduction

This manual describes the use of programs and a personal computer (PC) to control two transient digitizers through the General Purpose Interface Bus (GPIB). There are seven programs for this purpose which provide for the control of the digitizers through the GPIB, the verification of their proper operation, the collection (and later retrieval) of the data, and the management of the collected data files.

The 7912AD transient digitizer data collection program is designed to assist the operator in completing the control, acquisition, and filing stages while minimizing the possibility of error. Other programs provide device damage power calculation and assist the operator in locating a desired data file for retrieval and display and in searching for specific information contained within a data file. Also presented are methods for maintaining the diskettes and copying data and other pertinent information.

Seven of the programs are loaded into, and removed from, the PC memory by the eighth, called the "Menu" by convention. All the other programs contain the option to return to this menu (7912 Main Menu). As the operation center of this system of programs, the 7912 Menu can be automatically loaded into memory when the PC line power is applied.

2. The IBM-PC Computer

The computer described in this manual is an IBM-AT, which is the property of the Harry Diamond Laboratories (HDL); it is a PC with one hard or permanently resident disk and another drive for removable flexible (floppy) diskettes. The hard disk has space for ~30 megabytes (Mb) of storage, while a floppy might hold ~1.2 Mb. The computer has a memory size of 640 kb. The software described in this manual will work on any XT- or AT-compatible PC with at least 512 kb of memory. Accessories include a color graphics monitor adapter, math coprocessor, matrix printer with adapter, and adapters for asynchronous communications and the GPIB.[1]

Resident on the hard disk is the computer control software, known as Disc Operating System, Version 3.1 (DOS 3.1). Also present, but not directly controlling the computer, is the software BASICA, Version 3.0. The digitizer control programs are also resident on the hard disk. Drive A of the PC is used exclusively for data storage when these programs are in use.* Other software programs, such as PASCAL or "C," are used in this machine and may be made resident at any time.

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[1] *IEEE Standard No. 488.*

* *Both software programs are products of MICROSOFT Corporation.*

To operate this computer, you should read the IBM manuals "Guide to Operations, Personal Computer AT" and "DOS." While not essential, reading these books before using this manual is recommended. Some rudimentary operational necessities for this computer follow. Operations for compatible PC's are similar.

➤ (1) At the time the power is turned "ON" through a line voltage regulator/filter, the door to the floppy disk drive should be open. This will cause the resident control software on the hard disk to become operational. All that follows is contingent on this operation. If this door is closed at "power-up" time and a diskette which does not hold DOS software is present, the computer display terminal will display the message:

```
Non-system disk or disk error. Replace
and strike any key when ready
```

To continue operations, open the floppy disk drive door and hit any key. The computer will go through an operation known as "reboot" and load the appropriate software. A list of options, called a "menu" in computerese, should appear on the screen. Details about this and the other programs are found in section 5.

➤ (2) The power switch for the Epson printer is located at the back of the printer, left side. This switch should be turned on at the same time as the computer. Note that at some later time, the printer might be directed to operate by a program. An error will occur if that program cannot address the printer. Thus while not essential to the initial operations described in this manual, it is best to turn the printer ON with the computer.

➤ (3) Both the computer and display terminal will turn ON when the switch on the regulator/filter is activated. This regulator is a model KLR-500A, manufactured by Electronic Specialist, Inc. It is required that this filter be present to prevent transients on the power line from upsetting the memory or damaging the computer power supply. This device will be located somewhere near the computer, probably on the floor.

➤ (4) Never move the computer without taking special measures. The hard disk might be damaged if an operation called "Park" is not completed before the computer is moved. See the IBM "Guide to Operations, PC AT" manual for guidance and for the necessary software which is stored on a floppy disk kept in the flyleaf of the manual.

➤ (5) When using floppy disks (diskettes), which are the data recording media, observe the precautions found on the label or within the IBM manual. Do not bend diskettes or touch their operational surfaces.

These diskettes must be formatted before they can be used. This formatting is a computer process controlled through the DOS software. The "Guide to Operations" explains how this is done; however, 20 diskettes have currently been formatted and dedicated for use in device damage testing (DDT).

The resident control software (DOS) is an integral part of the programs used in DDT testing. Section 5 of this manual describes the DOS implementation.

➤ (6) The operation of any program in this manual can be stopped by simultaneously depressing the control key, labeled **Ctrl** (at the lower left corner of the keyboard) and the **Break** key (at the far upper right of the keyboard). If one were to compile these programs, it would be prudent to use compilation software which provides for the preservation of this option.

➤ (7) In most cases, a program stopped using step 6 above may be restarted by typing "RUN"* and striking the **Enter** key. The **Enter** key is left of the numeric keyboard (on the right), and has a left-pointing arrow with an upward tail.

3. General Purpose Interface Bus

The Institute of Electrical and Electronics Engineers (IEEE) devised standard number 488 as guidance for the design, manufacture, and implementation of a General Purpose Interface Bus (GPIB). This standard provides for the transmission of messages and signals to and from compatible instruments. In this application, the control signals and messages are sent to digitizers by the PC through an internal adapter board manufactured by National Instruments. The physical link is a 4-m-long multiconductor cable which attaches at the back of the computer and both digitizers. Up to 15 devices could be connected on this bus, but only two are used in this application.

The bus uses eight control lines and eight data lines. Transmissions on the bus occur bit parallel, byte serial. The National Instruments board, which provides direct memory access (DMA) to the PC, was purchased with software that has become part of the programs described in this manual. This software interprets BASIC language commands for compatibility with the GPIB.

When typing commands, you can use either upper or lower case letters.

The following manuals contain valuable information on the GPIB concept and operation:

(1) *GURU II GPIB User's Resource Utility for the IBM PC*, Tektronix, Inc. (1986).

(2) *GPIB-PC IEEE-488, Instrumentation Interface User Reference for the IBM PC*, National Instruments (1984).

(3) *7912AD Programmable Digitizer Operators Manual*, Tektronix Inc. (Rev 1983).

4. Transient Digitizers

The transient digitizers are two type 7912AD's by Tektronix, Inc. These wide-bandwidth instruments were designed primarily to capture fast, transient, analog events and provide an accurate digital representation of these events to the GPIB for transmission to a computer, and eventually to a storage medium (see fig. 1). The digitizers are programmable via the GPIB. That is,

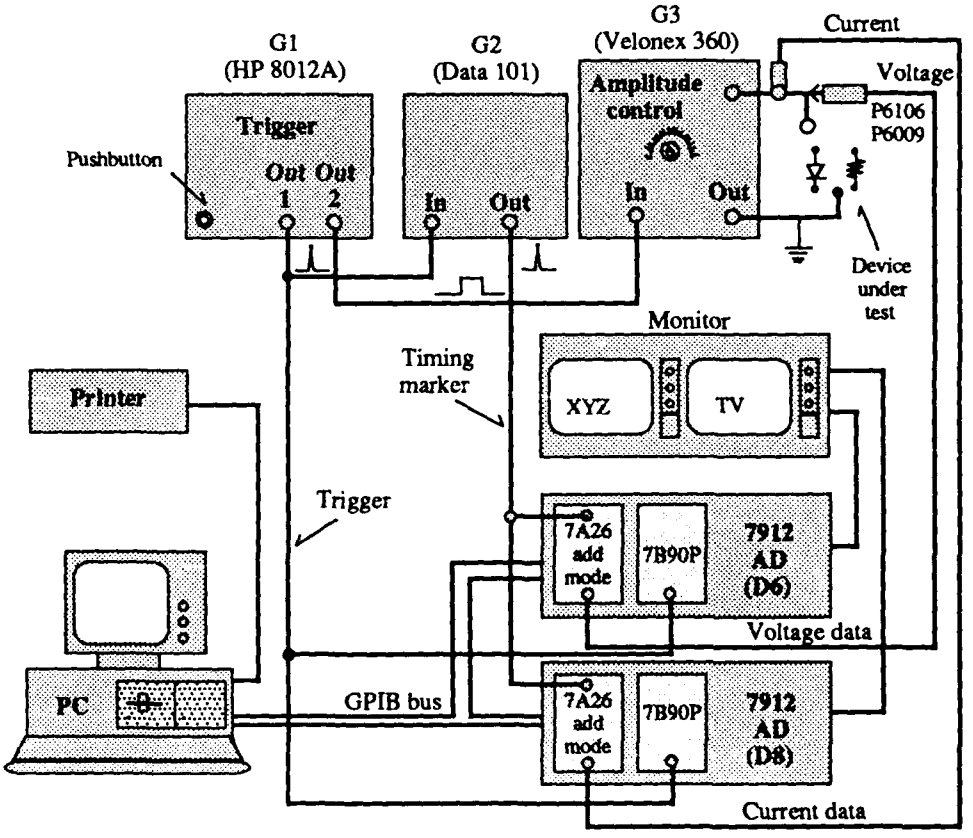


Figure 1. Digitizers, GPIB, and PC computer setup for DDT.

they can be instructed to perform all their operational capabilities under the control of a computer. This may occur in what is known as the "immediate mode," which is a command typed in at the computer keyboard, or through a program containing one, or many, commands. These programs are discussed in section 5 of this manual.

The digitizers are capable of bandwidths of up to 500 MHz if a Tektronix type 7A19 vertical amplifier is installed. This plug-in is required to measure rise times less than a nanosecond. These programs are compatible with the manufacturer's second generation of digitizers (Model 7912HB), which are even faster. The instruments are modular in design, in that either or both the vertical (input) amplifier or the horizontal sweep unit (time base) can be interchanged with other compatible "plug-ins."

For DDT, the initial work will use type 7A26 dual-trace amplifiers and type 7B90P horizontal time bases. The 1-MΩ input 7A26 will provide a bandwidth of ~200 MHz (rise time ≐ 1.8 ns) while the 7B90P yields usable time windows of from 5 ns to 10 ms. The 7B90P actually extends to include a 5-s data window, but the 7912AD will not digitize data at any rate slower than 1 ms/div (or a 10-ms window). This is a self-protective feature of the digitizer to prevent possible damage to an internal device known as the scan converter tube. This device is central to the digitizing operation. See the Tektronix 7912AD Programmable Digitizer Manual for a complete description of the instrument. The efficient use of these instruments requires the reading of that manual.

The outputs of the digitizers may be viewed on either a TV or a digital (X,Y,Z) monitor; these are the Tektronix instruments type 634 and type 624 monitors, respectively. If the digitizers are in the local mode (not under remote control), a front panel button is used to change from the TV to digital mode or digital to TV. If a continuous signal is present at either of the 7A26 inputs, it may be viewed on the TV monitor. If the digital button is depressed at that time, a single sweep of the continuous input will be digitized and presented on the digital monitor. This waveform will appear as two traces, describing the envelope of the data. The instrument captures and converts to a digital value many points at both the top and bottom of the trace. There are two vertical values for each point in time where a sample was taken, since the trace has vertical width. Later processing will average these two values to yield a single number, representative of the voltage at the input as a function of time. See the Tektronix 7912AD manual for a complete description of this processing and digitization in general. Digitization is an approximation of an analog event, and one should be aware of its limitations.

To digitize a transient event in the local mode, set the 7B90P to the single sweep mode at the appropriate trigger mode and time per division. With the

7A26 input properly adjusted, press the front panel **Digital** button, and the digitizer waits for the single sweep to activate before digitization takes place. The main intensity for the digitizer must be set to the proper level.

You can perform an exercise for single sweep operations by using a pulse generator capable of continuous or single pulse operation, as follows:

➤ (1) Turn the main intensity on the digitizer to minimum counter-clockwise (CCW).

➤ (2) Turn the digitizer power ON; wait for a few minutes.

➤ (3) While waiting, you could attach the output of the pulse generator (a Data Pulse Model 101 is OK) to either input of the 7A26. Do not turn on the pulse generator.

➤ (4) Put the 7A26 controls to

TRIGGER SOURCE:	MODE
DISPLAY MODE:	ADD
POLARITY:	As required by pulse
BW:	FULL
INPUT COUPLERS:	AC (alternating current)
VOLTS/DIV:	As required
POSITIONS:	Mid point

If you expect a 5-V pulse, put the volts per division to 5 V/div, to be sure that you see it on the early attempts. You can refine this later.

Put the 7B90P controls to

MODE:	PP AUTO (for peak/peak auto)
COUPLING:	AC
SOURCE:	INT (for internal) or
	LINE (for power line)
MAG:	OFF
POSITION:	Mid point
LEVEL:	Mid point
TIME:	As required by pulse
	but not > 1 ms/div

➤ (5) With the digitizer **Local** light ON, depress the **TV** button and slowly raise the intensity control until you see a trace on the TV monitor. The monitor should be displaying a video representation of the scanning trace being

internally generated by the 7B90P (PP AUTO), and the time per division should appear in the upper right-hand corner of the TV monitor. The voltage settings per division of the 7A26 should be present in the upper left and lower left corners of the screen.

Adjust the trace, horizontally with the 7B90P position control and vertically with the 7A26 control, for the input where the pulse will be applied.

➤ (6) If some time passes under these conditions, you might see the message TIME OUT OCCURRED on the TV monitor. To get the trace back, depress the **Digital** button and then the **TV** button. The trace should return.

➤ (7) With the trace displayed on the TV monitor, slowly turn up (clockwise—CW) the outer ring of the center digitizer control, labeled **Graticule**. The TV screen should display a graticule that is being internally generated by the 7912AD. Center the trace and turn the graticule off.

➤ (8) With the pulse generator still OFF, depress the **Digital** button. The TV monitor should blank, and the digital monitor should display the upper and lower portions of the digitized trace.

If the traces are not continuous, the intensity was too low. Return to TV mode and increase the intensity if necessary. Depress the **Digital** button. Experiment with various intensities and alternate between television and **Digital** modes, observing the results. Do not use excessive intensity. You will be warned of this by a light next to the **Main** intensity knob. This light, labeled **Decrease intensity**, will appear when the brightness is excessive. Experiment with the **Focus** control as well.

➤ (9) Decrease the intensity to minimum (CCW) and turn on the pulse generator in the continuous mode. In the TV mode, slowly increase the intensity. You should see the pulse, or at least part of it, on the TV monitor. The 7B90 mode **Selector** may be in normal (**Norm**) mode if you wish. Adjust the intensity and plug-in controls for amplitude and time until you have the desired TV monitor display. You could be using the calibrator signal from an oscilloscope for this purpose. By turning ON the graticule, you could check the digitizer calibration in this manner.

Depress the **Digital** button and observe the effect of digitizing one sweep of this repetitive pulse. Experiment with the controls (within limits for the intensity). Note what happens when you digitize the waveform with the graticule ON. The digitized graticule is mixed with the data, yielding what may best be described as junk. Be sure that the graticule is OFF (CCW) before collecting data. In the data collection programs described in section 5, the graticule is turned off for you by a coded signal from the

computer over the GPIB. If you are using the digitizers with some other device as controller, be sure that the graticule is off.

➤ (10) Put the pulse generator control to **Single pulse**, the 7B90P mode to **Norm** (for normal), and the 7912AD to the **TV** mode. Depress the pulse generator **Single Pulse** button several times and observe the TV monitor. You should see a faint pulse each time the single pulse button is depressed.

Place the 7B90P mode to the single sweep (**SGL SWP**) position and note that the nearby light, labeled **Ready**, comes on. The digitizer is now set up for single-sweep transient recording. When you depress the pulse generator single sweep button, the **Ready** light should go out, and a digitized trace should appear on the XYZ monitor. Experiment with this operation by resetting the single sweep on the 7B90P and pressing the generator single pulse button. To get "new" data in the digitizer for each pulse you apply, you must cycle through the TV mode. Note that when you go from **Digital** to **TV** to **Digital**, the XYZ monitor display disappears. Reset the single sweep, pulse, and observe. Repeat this until you feel comfortable with the operation. When you are through, turn the digitizer intensity down (CCW). Always try to turn the intensity off when the instrument is not actually in use.

The proper operation of these digitizers, within the framework of the data collection program (sect. 5), is dependent on the previously described setup. If the transient event can be captured and displayed on the XYZ monitor, the programs will take it from there. The quality of the data is dependent on the experience and knowledge of the operator of the digitizers. Data quality guidelines should be established on a test by test basis. The computer can be helpful in post-data-collection evaluation, but at the time of collection, the judgment of the operator is all important.

5. Programs

The digitizers are partially controlled by programs written in the BASICA computer language. The term "partially" is used because the data collection program does not determine when the data are collected or whether they are acceptable. The program retrieves whatever data are stored in the digitizers, on the command of the operator.

Before the programs can be explained, you must first understand the role of the resident software which controls the computer. A previous reading of chapter 1 of the IBM DOS manual would be helpful.

5.1 Disk Operating System (DOS)—The Automatic Execution File (AUTOEXEC.BAT)

When the PC is first powered up, many internal checks are performed by the DOS software. An external indication of one of these checks is a display of characters in the upper left corner of the display monitor. The memory locations of the computer are being checked for their performance.

The PC has a built-in clock and calendar which can be reset under DOS control. These functions are important to the digitizer programs and must be properly set, as becomes evident later in this manual.

While several operations must occur before the computer is ready to function, only a few will be discussed here. Among these is a file, consulted by the computer at powerup time, called AUTOEXEC.BAT.

The DOS software is written so that any file with the exact name AUTOEXEC.BAT is executed when the computer begins operations. This file contains many user-variable instructions which the computer will execute. This file, resident on the PC hard disk, has been altered to meet the particular needs of the programs described in this manual. Some of the instructions that are executed are as follows.

The VERIFY command in DOS is turned ON. When this command is executed, DOS will check the validity of any data written to either the hard disk or the diskette (floppy). Although VERIFY increases execution time when data are written, it is worth it. If a fault occurs, the VERIFY command will warn you so that you can take appropriate steps to save your data (or program). The VERIFY command is automatically installed by AUTOEXEC.BAT.

The computer is instructed to look for further instructions located in several other areas of the hard disk. These areas are defined as directories. For instance, in one of these directories, the computer will learn that it is expected to act as a controller for the GPIB board. Information is input (automatically) which informs the computer of how the GPIB and the digitizers are configured. In this manner, communications between the instruments and the computer can later be established.

The AUTOEXEC file also tells the computer that it will be expected to perform graphic functions. This causes certain areas of memory to be allocated for later use and the GRAPHICS software to be available upon command.

The last execution in the AUTOEXEC file causes the computer to change directory to the area on the hard disk where the operational programs for this

manual are located. As part of this operation, the BASICA IBM interpreter is loaded into memory and the computer is told to load the first program, called Menu.

5.2 BASICA Programs

Whenever a series of interrelated programs are written, there must be some means of accessing each of them. The conventional method is to write a program from which any of the other programs may be brought into the computer memory. This central access program is usually called a menu. Like other menus, the function of this program is to list what is available to you. In some manner, it will list the other programs and tell you how to get to them. Once any of these other programs have been loaded and executed, the computer will return to the menu, either through an instruction in the code of the loaded program or through your executing an option to do so which was written into the loaded program.

This is the format for the programs that follow. These programs might be considered a software system with the 7912 Main Menu program as the system driver. Appendix A is a diagram of the 7912 Main Menu and its interrelationship with the programs.

5.2.1 Opening Menu Program

When the computer has finished its initialization operations, as previously described, the display terminal will appear as seen in figure 2. This display is the result of a BASIC language program, resident on the hard disk, which was automatically executed by the AUTOEXEC file.

Please note: the first menu (Opening Menu) and all the programs that it can access are available only in the in-house HDL software package. The reader who has only the 7912 programs should proceed to section 5.2.2, where the 7912 transient digitizer menu is discussed.

As stated, you have five options, as expressed on the screen. You execute these options by pressing one of the five function keys listed on the screen. The computer will not accept the input of any but these keys for this operation.

Figure 2. First, or Opening, Menu program.

```
        date:02-08-1988 time : 10:44
  CURRENTLY AVAILABLE PROGRAM GROUPS:
  (1) DATA ACQUISITION PROGRAMS
  (2) DATA MANIPULATION PROGRAMS
  (3) UTILITY PROGRAMS
  (4) return to DOS control
  (5) go to BASICA
  .....Input your choice please
```

Options 4 and 5 are included for users who wish to operate the computer under their individual control. If you select options 1 through 3, the screen will blank for a moment and further options will appear. Figure 3 shows how the monitor screen would appear if option 1 were selected.

Figure 3. Data acquisition menu.

```
DATA ACQUISITION MENU CHOICES:
(1) 7912AD transient digitizer data acquisition programs
(2) DCS (digital camera system) data acquisition programs
(3) 7954 (DPO) data acquisition programs
(4) 7612 transient digitizer programs
(5) Return to Opening Menu
. . . . .Input your choice please
```

The names of these programs, as they are filed on the hard disk, are meaningless to this manual. What is important are the functions these programs perform. The options were condensed so that all five could be displayed on one screen (or page). We hope that each listed phrase is meaningful to the user.

As is apparent from figure 3, four instruments can be controlled by in-house programs and commercial software resident on the hard disk of the computer. While this manual deals only with the 7912AD software, it may be useful to know that separately the other three instruments can also be applied to your needs. Briefly, the instruments are the Digitizing Camera System (DCS), the 7854 digital processing oscilloscope, and the 7612 transient digitizer. All these devices are manufactured by Tektronix Inc.; you should consult the appropriate manual for possible applications.

Depressing the number 1 key will load into memory programs which deal with the control of the 7912AD transient digitizer. These programs will be discussed shortly. The number 5 key would cause the Opening Menu (fig. 2) to appear on the screen. If from this menu, you had chosen the number 2 option, the screen would blank and appear as in figure 4.

Figure 4. Data manipulation menu.

```
DATA MANIPULATION MENU CHOICES:
(1) Power computations through the DDT (Pascal) routines
(2) DDT waveform processing; FFT, integration, scaling, etc
(3) Use the H.P. graphics plotter to present DDT data
(4) Return to the Opening Menu
Note:  data must be Device Damage Testing (DDT) format
Input your choice please
```

The menu seen in figure 4 is used to load programs which will perform mathematical operations on previously collected DDT data files (option 1 or 2) or present those files as plotted by the Hewlett Packard multicolor plotter (option 3). The last choice (option 4) would return you to the Opening Menu (fig. 2).

Referring once more to the Opening Menu (fig. 2), if you had chosen option 3, the screen would blank and appear as in figure 5.

Figure 5. Utility programs menu.

```
UTILITY PROGRAMS MENU CHOICES:
(1)  DADiSP  software (waveform creation and/or processing)
(2)  Retrieve "lost" files or data; also check disks
(3)  Operate the SPD (Tektronix) software
(4)  Return to Opening Menu
(5)  Search any disk, any drive, for file information
Input your choice please
```

The first three options in this menu will load commercial software into memory. Each of these commercially available packages comes with its own operations manual that must be read before the program is applied. A means for waveform manipulation for data collected by the 7912 programs could be devised for options 1 and 2, but is not provided in this manual. If you have the time to do so, these options could be useful to you. Option 4 will return you to the Opening Menu; option 5 will load into memory a program to search for a data file.

Figure 5 is the last of the four possible screens that you might see while in the Opening Menu program. Referring once more to figure 2 (the first "page") and to figure 3, if option 1 had been chosen in each menu, the screen would blank and appear as in figure 6. This is the main menu for the 7912 programs (see app A).

5.2.2 7912 Transient Digitizer Menu

Please note that the 7912 Opening Menu, seen in figure 6, is the first one available to non-HDL users of the 7912 software package. If you have the programs on a disk, a file named 7912.BAT should be present. If so, you may load the 7912 menu by typing "7912" from the DOS prompt.

This menu (seen below) provides a means to move easily from one 7912 program to another. Note that since it is the main menu for the programs discussed here, the 7912 menu is hereafter referred to as the "Main Menu." What each function key provides should be evident from the comments listed next to it. A more detailed discussion of each key's function follows.

Each key, and its function, is discussed in order, as the keys appear on the screen. A data collection program functional chart appears in appendix B. (The Menu program is provided in app C.)

Figure 6. 7912AD transient digitizer Main Menu.

```
DDT MENU for using the 7912AD Transient Digitizer
USE A FUNCTION KEY FOR YOUR CHOICE OF ONE OF THE OPTIONS BELOW:
F1 ..... A TUTORIAL ON THESE PROGRAMS
F2 ..... DATA COLLECTION PROCEDURES
F3 ..... GRAPH DATA STORED ON A DISK
F4 ..... REVIEW THE "SHOT" FILE
F5 ..... NUMBER (or check) THE DATA DISK
F6 ..... SEARCH FOR A DATA FILE
F7 ..... MAKE A COPY OF A DATA DISK
F8 ..... MAKE A COPY OF THE "SHOT FILE"
F9 ..... POWER COMPUTATIONS
F10 ..... RETURN TO DOS
```

5.2.3 F1: Tutorial Key (App D)

If you are at the display terminal at this time, press the F1 key. If not, see figure 7 for what would be displayed on the screen.

By pressing the F1 key, you cause the computer to "dump" the Main Menu, then load and execute a program which prints the information seen on the screen (or fig. 7). This program has options within it that are displayed for you at the bottom of the screen. If you desire, the program will display 10 pages of text, one at a time, as you press the letter key "n" (for next page). The letter inputs, for this and the programs which follow, may be either lower or upper case.

```
PROGRAM NAME: "TUTOR.DDT"      PAGE 1 OF (10)  MAY 87/JJL

These programs were written to control and file data from two type 7912AD
(Tektronix) transient digitizers. They are numbered 6 and 8 on the front
panels.

The digitizers are controlled by an IBM PC through the GPIB (general  purpose
interface bus) and a National Instruments GPIB control card installed within
the computer. The digitizers and computer are linked by the GPIB multi-
conductor cable. At this time (Feb 1989) the computer and digitizers may be
separated physically by no more than the length of this cable, approximately
three meters.

The programs are written in the BASIC computer language using IBM advanced
basic or BASICA Ver 3.0. They are stored on the hard disk (drive: c) of the
Branch 21400 IBM PC with the HDL Bar Code Property #58186. Copies are present
on floppy disks.

Input "n" (next page), "p" (previous page), or "m" (main menu)
```

Figure 7. Tutorial program, page 1.

Each page of this tutorial presents information about the measurement system and the programs. Although brief, the tutorial may be of use at some time. The programs described in this manual are intended to be stored on a disk compatible with the IBM PC and made available through the National Technical Information Service (NTIS). If this takes place, the required commercial software (GURU II by Tektronix) must be purchased separately.

If you choose to read the tutorial you will find the same options at the bottom of each page. Each time, you may go to the next page (n), go to the previous page (p), or dump the tutorial program and return to the Main Menu (m). The program is written so that only the letters "n," "p," and "m" will be accepted. If you make a mistake, the program will show you and ask for another input of one of these letters. If you are at the terminal now, try it; you will not hurt anything. Next, use the "m" input to return to the Main Menu. You will see the original display (fig. 6) quickly appear on the screen. Experiment by using the F1 key again to return to the tutorial. In this way you can observe that the menu process is fast and easy.

If you finish reading the tutorial, or just "page" through to the end, you will be presented with the options of repeating the tutorial or returning to the Main Menu.

When the display screen exhibits figure 6, this indicates that the computer memory is loaded with the 7912 Main Menu program. Within the programs that follow are other menus. In fact, the choices seen at the bottom of figure 7 from the tutorial program might be considered a mini-menu.

Keep in mind that any program loaded by the 7912 Main Menu (such as the tutorial program) will contain within it the option to return to the 7912 Main Menu. This provides a flexibility which is essential to efficient operation of the programs.

5.2.4 F2: Collect Data

If you see the Main Menu displayed on the screen (fig. 6), you can access the data collection program with the F2 key. You may do this as an exercise, without intending to actually collect data. In fact, you are encouraged to do so, provided the instruments are attached (see fig. 1) and functioning. Remember to be sure that the intensity controls are at minimum before the primary power is applied to the digitizers.

The data collection program has been written to make the process as simple and efficient as possible. Many routines within this program are transparent to the operator, in that no indication is presented on the screen. These operations, explained here, include subroutines, called "error traps," within the program. We are all subject to making errors, as anyone who has ever

written a computer program may verify. These "traps" are designed to prevent human or machine error from causing the program to cease executing. A step-by-step process through the data collection program is listed here. The program begins appropriately enough with an error trap.

If the F2 key is depressed when the Main Menu is displayed on the screen, the menu program is dumped and the data collection program is loaded into the PC memory. The monitor screen will blank and the program name will appear on the screen. Program execution begins automatically and is as follows:

Step 1

The program examines the floppy disk in drive A. If the door to drive A is open, or no disk is present, a `DISC NOT READY` message will appear on the screen, and the program will wait indefinitely for corrective action to be taken. When a disk has been inserted and the door closed, striking any key will cause program execution to continue.

Step 2

The program again examines the diskette in drive "A," looking for something called a disk number. The efficient retrieval of data requires a system by which the diskette where the information is stored can be identified. For device damage testing a numbering system has been devised in which a program actually writes an identifying number directly on the floppy disk. If this process had not been completed for the disk currently in use, a message to that effect would be printed on the screen and the program would wait for you to read it. Striking any key would then return you to the Main Menu where you can select the option (F5) to number, or check the number of, the data floppy disk. This is discussed in more detail in section 5.2.7.

If the disk had been numbered and the drive door closed, these steps would have been transparent to the operator. If there had been data bearing the current date present on the disk, the last file number would be printed on the screen as an aid to memory. If the program finds that nonconsecutive pulse numbers have been recorded for this day's data, a warning is displayed. If no data for this date are found, an appropriate message is displayed. The file names, numbers, and dates are discussed further in step 9.

Step 3

The interpretive software, which provides the means for communicating with the digitizers, is loaded into memory.

The steps listed above are completed quickly. The program waits so that the operator can observe the numbers of the data files for this day, and returns to the menu or continues, depending upon the key that is struck.

Step 4

If the door to the floppy drive had been closed and a valid disk inserted, no errors would have occurred and the screen would appear as in figure 8.

Figure 8. Data collection program, *conditions normal.*

```
The 7912 Data Collection Program for Device Damage Testing.
Data will be stored on Data Disk # ( )
No data found on disk A for (today)
>>    Hit "M" to return to Menu or  <<
>>    Hit any other key to continue.  <<
```

Step 5

The program continues, checking the GPIB board within the computer, the GPIB bus, and the digitizers. As an example of this checking, figure 9 shows how the monitor screen would appear if a digitizer's power was not turned on.

Figure 9. Display of power-off error condition in data collection program.

```
gpib error 2
no listener on write function; is power "on" ?
STOPPING BECAUSE OF ERROR; TAKE CORRECTIVE ACTION
>> HIT ANY KEY WHEN READY TO RE-START PROGRAM <<
```

When any key is struck, the program loops back to the beginning and, if no error conditions exist, causes the digitizers to go to the LOCAL mode. If you want to adjust the digitizers, you can do so; the program execution will continue when you strike any key.

Step 6

When a key is struck, the screen blanks and displays the text seen in figure 10. At this time, the digitizers are observed to be in the REMOTE state while the screen displays the vertical settings (two) and the horizontal time (one) for each digitizer. Just before the operation which read out these settings, the program caused some of the settings in the digitizer to change. The GPIB error routine examined this operation and assured that it worked properly. The original settings were then written back into the instruments.

Figure 10. Data collection program, page 2.

```
.....PUTTING IN DIGITIZER SETTINGS.....
D6.....confirms settings
D8.....confirms settings

digitizer #6, both vertical plug-ins and time base settings:
VS1 +2E+00;    VS2 +2.E+00;  time base = HS1 +1.E-06;
digitizer #8, both vertical plug-ins and time base settings:
VS1 +2E+00;    VS2 +2.E+00;  time base = HS1 +1.E-06;

>>>>  NEXT PAGE HAS OPTIONS TO CHANGE SETTINGS  <<<<
>>>>    HIT ANY KEY TO CONTINUE    <<<<
```

If the digitizers were not set to the same time per division, a warning message would have been printed on the screen. For device damage testing, it is required that each instrument examine the same time window.

Step 7

When any key is struck, the third page of text is displayed (fig. 11). This is a menu of options within the data collection program. These options are chosen by the number keys (not function keys) 1 through 4.

To digress for a moment, note the text at the top of the screen (or figure) saying "NOTES (if any) :". If in the most previous part of the program, the time bases for both digitizers had not been the same, a message would have been displayed as a reminder to adjust the time/division before collecting data. If a number key other than 1 through 4 is entered as an option choice, the screen will blank and the text will reappear with the note changed to read INVALID INPUT, PLEASE USE NUMBERS "1" THRU "4." If a letter key is inadvertently entered, the message "Redo from start" will appear. Other notes might appear when the data collection program menu is accessed again.

Figure 11. Data collection program, page 3, data menu.

```
PROGRAM NAME:   START                    March 89  JJL
>>>> NOTES (if any):
CHOICES AT THIS POINT:
(1) Return digitizers to the local mode (to adjust
     settings)
(2) Digitize and file single sweep data from both
     digitizers
(3) Return to the 7912 menu
(4) Return to IBM DOS control of computer
INPUT YOUR CHOICE AS A NUMBER KEY, "1" THROUGH "4"
```

If option 1 is selected, the program begins again. Option 2 continues the program while option 3 will return the Main Menu program. Option 4 will dump the program and pass control of the computer from BASICA to DOS. This option is for those familiar with the PC. For now, we will select option 2 to continue the program; the screen will blank and the text of figure 12 will appear.

Figure 12. Data collection program monitor presentation, page 4.

```
SINGLE SHOT DATA COLLECTION PROCEDURE FOR DEVICE DAMAGE
  TESTING
The digitizers are in the LOCAL operation mode.
When you have the data that you want in the
digitizers (as seen on the digital monitor)
hit the "y" (for yes) key.
To EXIT back to menu, hit "n" (for no).
........Input (y) or(n) when the digitizers are ready.
```

Step 8

The digitizers are once more in the local mode. The program will wait here as long as you wish. If, for some reason, you want to return to the previous page where the options are (fig. 11), you can input an "n," for "not ready." The program will only accept an "n" or "y" in any case.

At this point, it is up to you to get the required responses in each digitizer. As an example, if the exercise of section 4 were implemented, a pulse would be captured by both digitizers. When the results are as you want them, as observable on the XYZ monitor, input the "y" key (either upper or lower case).

Step 9

A message will appear asking for a file number for the data about to be collected. The file name is structured so that no two data sets should ever have the same name. A number between 001 and 999 must be input at this time. Other inputs will be rejected until this is done. The number input will form what is known as the file name extension. The computer will form the rest of the file name. As an example, it was previously mentioned that the computer's ability to keep track of the current date was important. When the file number is input to the program, the date is found within the PC memory and reformed because of a maximum allowable length for a file name. In memory, the 4th of July for 1987 would be presented on the screen as `07-04-1987`. The program would reform this to `070487` and add either the characters `D6` for digitizer No. 6 data or `D8` for the other digitizer. The file names of all data for this day would be either `D6070487` or `D8070487`. Each piece of data for this day would be distinguished by the number that is input. If this were the first file of the day, the file name for each digitizer waveform would be `D6070487.001` and `D8070487.001`. A routine later in this program prevents the same file number from being used twice.

Step 10

After the file number has been input, the screen blanks once again and interim messages of the data acquisition process are printed on the screen. A message appears informing you that the command has been sent to the digitizers to send their waveforms over the GPIB, and when the waveforms are in memory, this too is signified. You might note at this time that the XYZ presentation has changed from a double to a single trace. This is because the program commands the digitizers to average to center (ATC).

Step 11

With the end of the acquisition, the messages `correcting for ATC` and `normalization to baseline` will appear. Baseline normalization

means that these programs assume that the first half of the first division of the time window represents 0 V. There can be *no data* present during this time. If the baseline is not at 0 V, the program will force it to that value. To exhibit any dc offset in the data some separate post-collection data processing must be incorporated. Section 6 contains information on the limits and requirements for device damage testing. The program will take the mean value of the first-half time division and subtract it from the entire waveform. The "baseline" will then be at 0 V. The program will issue a warning if one-half division of baseline is not found. The program also issues a screen warning if more than 10 consecutive waveform points were interpolated by the digitizer.

The next step is to correct the waveform for the ATC process. Each digitizer provides both an upper and a lower trace; therefore, the computer must divide the sum that results by two. The execution time for these operations is approximately 10 s.

Step 12

The screen will blank once more and print that the maximum and minimum waveform parameters are being calculated. These values are presented along with the times at which the maximums occur.

Next, the program consults a hard disk file for the last probes used in data collection. These probes and their transfer functions are presented, and may be changed as required. A probe serial number may be added to the name, if desired. Inputs for data annotation and the device under test (DUT) are also requested. The program converts all letter characters to upper case form for a uniformity of input that is required for the data file search programs (see sect. 5). These inputs are then presented for review with an option to change them if necessary before you continue. When you indicate that these inputs are satisfactory, the program proceeds to graph the waveforms.

Step 13

The digitized waveforms, representative of the input voltage to each digitizer, appear on the screen (see fig. 13). The program pauses at this point to allow you to make a hard copy of the screen. The printer is operated by pressing the "print screen" key, usually on the upper right side of the keyboard.

The digitizer outputs are identified by the file names on the right, with the upper waveform from digitizer No. 6 (file name begins with "D6") and the lower from digitizer No. 8. In addition to the calculated parameters and some of the inputs made in step 12, the graph displays the number of the disk on which the data will be filed.

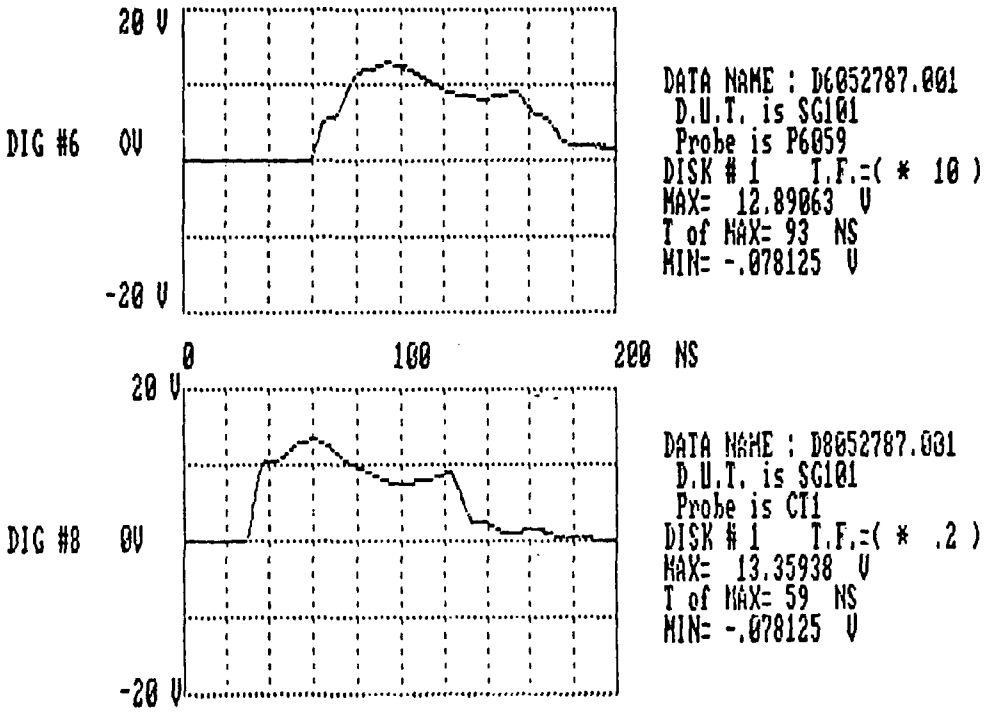


Figure 13. Data from Epson printer.

Step 14

Striking any key will produce options for saving or rejecting these data, or for returning to the Main Menu. If the printer is reproducing the graph when the key is struck, the printing will continue and the options will appear at its completion. If the save option is chosen, any warnings previously displayed during this data cycle are presented again. If you choose to ignore these warnings, the screen will blank, and the message `Please wait...filing the data` will appear.

The small red light on drive A will blink as the data are written to the disk. The process is being verified by the computer so that there can be a high degree of confidence in the quality of the recording.

Step 15

The completion of the filing cycle causes the program to loop back to the beginning where under the heading of `DATA FILED` (fig. 8), the file numbers of all data for the day are listed. You can now repeat the data collection procedure or exit to the Main Menu.

All the steps to this program were not presented here. For instance, every time a command is sent to a digitizer or a response received, an error routine checks the validity of the operation. During the data filing routine, some information about the test that was conducted is filed on the hard disk. This is explained in section 5.2.6. While this discussion of the data collection option is not

complete, it should yield an understanding of what happens when the program is executed. This program and those that follow in this manual are printed in the appendices (see app D through I).

5.2.5 *F3: Graph Data*

If the number 3 key is selected (see fig. 11) from the data collection program menu, the Main Menu is again presented on the screen. Function key F3 will permit the graphing of any data currently stored on any disk in any drive. These data had to be collected through the data collection program (5.2.4) or have exactly the same format as that used to file the data from this program.

The initial presentation of waveforms from this program is the same as that of the data collection program (fig. 13). The user is asked to input the disk drive where the data disk is located. The program will then search the disk in the specified drive for all 7912AD data. The results of the search are presented on the monitor screen. You can graph any file by choosing the number printed on the screen which corresponds to the data. After the initial presentation of the raw data (fig. 14a), options are presented for scaling the data (applying the probe transfer functions to the waveforms), expanding the data (displaying a particular time segment), or graphing another data set. Figure 14b shows the result of choosing the amplitude scaling and time expansion options. In both waveforms, the transfer functions of the probes have been applied. Each time you choose this last option, the program offers the option of retrieving more data or returning to the Main Menu.

5.2.6 *F4: Review the Shot File*

As mentioned at the end of the data collection program discussion (sect. 5.2.4), besides storing the data file on a flexible diskette in drive A, the program also saves some information about the data in a file on drive C, the hard disk.

This area on the disk, addressed as the "Shot File," is different from a data file in that it is always present on the hard disk and will increase in size each time the data collection program is used. The Shot File, designed to act as an aid in finding data files, has several other useful features.

The information stored in this file by the data collection program includes everything about the data but the waveform. This includes the data file name, the number of the flexible disk where the file was stored, the DUT, the probes used and their transfer function, the time and (of course) date of the recording, the annotation input at that time, plus the waveform parameters. While this might seem to be a great deal of information to be filed for each piece of data, it does not consume that much storage space on the disk. Currently, the disk

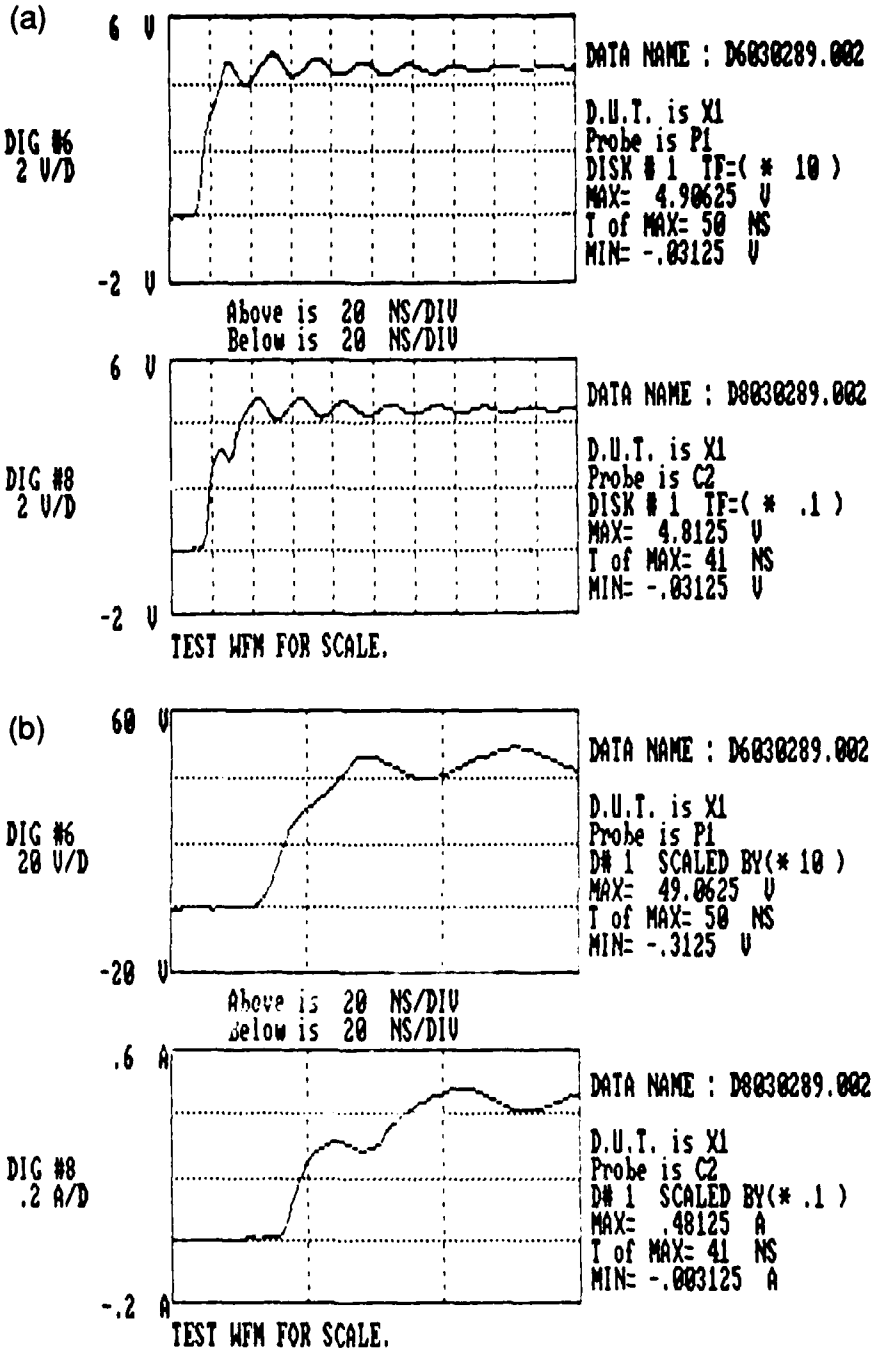


Figure 14. Graphic presentation of (a) raw data and (b) time windowed, amplitude scaled data.

has room for the file to increase in size to store information from 4000 data recordings. More room on the hard disk may easily be allocated if required. Provisions have been made to copy the Shot File, as will be noted later.

If, from the 7912 Menu program, you were to select the F4 key, the Shot File program would be loaded into memory and the display screen would appear as in figure 15. Note that while this is the Shot File program, another menu has

appeared on the screen, providing you with eight options. As with the other programs, the option exists to return to the 7912 Main Menu (F6 key). The program will convert any lowercase letter input to uppercase for conformity to the data collection program inputs. In the search routines that follow, this is particularly useful. Discussion of the other options follows with examples of the resulting displays.

Figure 15. Shot File program menu.

The Shot File is now in memory. Your options are:

```
key                option
F1 ..... Display the entire file on the screen
F2 ..... Print the entire file on the printer
F3 ..... Search for a specific file name
F4 ..... Search for a particular word or phrase
         in the annotation
F5 ..... Search for a specific device name
F6 ..... Return to the main menu program
F7 ..... For some "hints" on searching
F8 ..... Copy the shot file to a floppy disk
Your choice?
```

F1: Display entire file on the screen

To display the entire shot file, depress the F1 key. The screen will blank and the query

"Do you wish to limit the display to a certain day?"

will appear. If the answer is "y" (yes), an input for the requested date appears. If the response is "n" (no), the entire file is displayed. Figure 16 shows the screen display for one "page" of the Shot File. The entire file may be seen if you "page" through it by striking any key, as noted on the screen.

Figure 16. Display of Shot File.

```
D6051287.005 Disk #1   Vmax = 2.1875  t.f. = * 1
Device Under Test (D.U.T.): SG503A  Probe = P6957
Annotation:  COMMENTS GO HERE ..... END COMMENTS
D8051287.005 Disk #1   Vmax = 4.65625  t.f. = * .2
Device Under Test (D.U.T.): SG503A  Probe = CT1
Annotation:  COMMENTS GO HERE ..... END COMMENTS

D6051287.001 Disk #1   Vmax = 4.21875  t.f. = * 1
Device Under Test (D.U.T.): SG101  Probe = P6054
Annotation:  COMMENTS GO HERE ..... END OF COMMENTS
D8051287.001 Disk #1   Vmax = 4.59375  t.f. = * .2
Device Under Test (D.U.T.):  SG101  Probe = CT1
Annotation:  COMMENTS GO HERE .....END OF COMMENTS
D6051287.002 Disk #1 Vmax = 1.65625  t.f. = * 1
```

The data information is grouped in pairs since that is how it was collected. At a glance, you can see what device was tested on a given day and on which disk the data reside. This particular information comes from data files created to test these programs.

F2: Print entire file on the printer

Here the Shot File will be printed directly on the printer. The same option exists to limit the printing to the files found on one particular day.

F3: Search for specific file name

This key loads a subroutine for the Shot-File program which searches only for a particular data file. After some months of testing, there should be many data disks, all filled with data files. While each graph of data has the storage disk number printed on it, searching for the hard copy, if one was made, may be inconvenient. This option quickly yields the information about the disk number, device under test, etc.

F4: Search for a particular word or phrase in the annotation

This option searches through the annotation segments of every file looking for a word, partial word, number, or phrase that you choose. As an example, if some of the DUT's were manufactured by the General Electric Co., and in the data collection program you had noted through the annotation portion that "MFGR=G.E." you could command all files to be searched for the phrase "MFGR=G.E." Perhaps more easily, you could simply search for "G.E." Every file name containing the search material will be printed for you on the screen.

F5: Search for a specific device name

This option searches the file for every occurrence of the name of a particular DUT. For example, if you select this option and in reply to the screen request for the device name, you input SG202, the last two file names of figure 15 would appear on the screen, since they contain SG202 as the DUT. Further, all other files found to contain this particular name would be presented.

The search is very specific. If the input was made with a space on either side of the name as in " SG202" or "SG202 ", no file would be displayed unless that space was also found. The input SG202, without spaces, would be successful. See figure 15 and the F7 key option discussion on searching files.

F6: Return to Main Menu program

This returns you to the 7912 Main Menu program. Each of the subroutines within this program (Shot File) provides the option to return, or automatically

returns, to the Shot-File menu (fig. 14), where the F6 key may be used to exit at any time.

F7: Hints on searching

If you depress this key, the screen displays the text seen in figure 17. These are suggestions on how to use the search capabilities of the program.

F8: Copy the stop file to floppy disk

If for any reason you want a copy of the Shot File, this option provides that capability. It guides you in the steps to be taken and then copies the Shot File on the flexible disk in drive A.

The Shot File is intended to be useful over the long term use of these programs. It should help you in forming a data base once many tests have been conducted. The program should be capable of processing up to 145 files at this time, as limited by the memory size of the PC. If you ever want to examine even more files, the program may be modified accordingly; however, the execution time will increase.

The inputs made by the operator during the data collection program are important if this program is to be as useful as possible. A consistent format should be used from the very beginning to conduct successful searches later on. As one last example, if for the manufacturer "General Electric" you input "G.E." in one file and "GE" in another, you can search for only one input

Figure 17. Shot File program monitor display of search techniques.

```
Some hints on how to search the shot file
Every time data were collected through the DDT
programs, the opportunity was present to file descriptive
annotation with the data. If you did this annotation, the
"shot file" would contain a copy of whatever text was input.

This program may be useful to you, in that you can search
through all this annotation for each occurrence of a given
word or phrase. For instance, you might wish to know what
data were filed for a particular device. If that device name
was input during the data annotation, then you can find the
file name and disk number with this program.

The key is to input exactly the same text, or even part
of the text. As an example, if you input "device 104" and the
original entry was "dev 104," the search would be fruitless.
If, however, you input only the numbers "104" then you would
be successful. It is best to be concise.

          >>>      HIT ANY KEY TO CONTINUE      <<<
```

when the program is run. The search routine may be modified to look for more than one name (an either/or search) but this will add to the execution time. It is best to decide what convention to use for descriptive inputs and then use it consistently.

As previously mentioned, you can leave the Shot File program by depressing the F6 key to return to the Main Menu.

5.2.7 *F5: Number the Data Diskette*

The F5 key in the Main Menu will load a short, but important, program. As described in the data collection program (sect. 5.2.4, step 2), a numbered diskette must be ready to use and properly contained in drive A of the PC before data can be collected. This is necessary so that at some future time you can locate the data easily by finding the diskette with the appropriate number. This number is filed with the data, stored in the Shot File, and presented with the waveforms (fig. 13).

Whenever you place a new data diskette in drive A, you should exercise the Main Menu option to number the diskette (F5 key). Otherwise, when the data collection program is executed (sect. 5.2.4, step 2), an error trap routine will prevent data collection. You will be notified that the program could not find a valid number on the diskette, and the 7912 menu will be accessed after you have read the message.

From the Main Menu, the F5 key will load in the disk numbering program and the screen will appear as in figure 18. This program can be used at any time without affecting the diskette. The program searches the disk for a number (1 to 999). If found, the number is displayed on the screen, and the program will reload the Main Menu after the message has been read. If no number is found, the program searches a file where previously used numbers are stored. Any number, not previously used, between 1 and 999 will be accepted and written on the diskette. If the next sequential number is not used, a warning is issued and options displayed. Sequential numbering is recommended but not re-

Figure 18. Number the data diskette program monitor display.

```
PROGRAM NAME:  "NUMDISK.DDT"            APR87  JJL
CHECKING TO SEE IF DISK ALREADY IS NUMBERED
A:/ |
DISKNUM.DDT |
|32768 Bytes free |
     >>>> DISK IS ALREADY NUMBERED AS SEEN BELOW <<<<
      A:DISKNUM.DDT
COMMENT:  DDT TESTS
DATE:  05-01-1987
TIME:  18:22:02
AND DISK NUMBER IS  (1)
RETURN TO MAIN MENU BY HITTING ANY KEY
```

quired. The next sequential number is found in the program by adding one to the last disk number used.

The screen reflects the successful numbering of the diskette and waits for this message to be read before the program returns control to the Main Menu.

5.2.8 *F6: Search for a Data File*

The F6 key causes the loading of the Shot File, where the option exists to search for a specific data file. See section 5.2.6, the F3 key option.

5.2.9 *F7: Copy a Data Disk*

If you want to copy a data diskette, this key will load a program for that purpose. Although the diskettes are highly reliable as storage media, a full diskette may represent several days' work. Thus, it is prudent to make a copy.

If Main Menu F7 key is depressed, the screen will appear as in figure 19. The step-by-step instructions, as presented on the screen by the program, are as follows:

1. Place the diskette to be copied in drive A.
2. The contents of this diskette are temporarily transferred to disk C.
3. Replace the original data diskette in drive A with a blank formatted diskette.
4. The data temporarily stored on drive C are written onto the diskette in drive A, including the original diskette number.
5. The temporary data file on drive C is destroyed. You can now remove the copy, and you should label it as such to avoid confusion with the original.
6. The option to copy another diskette or return to the Main Menu is presented on the screen.

Figure 19. Display of copy data diskette program.

```
PROGRAM NAME:  "COPYDAT.DDT"              MAY87  JJL
PURPOSE:   To make a backup copy of the disk in drive "A."
METHOD:    On command, this program will copy all files
           from the disk in drive "A" to a temporary master
           file on the hard disk (drive "C").

           On the next command, it will write the files back
           to drive "A," where you will have placed a blank
           formatted disk. The temporary file is deleted.

 OPTIONS:  (1) COMMENCE COPY PROCEDURE
           (2) RETURN TO MAIN MENU

 INPUT YOUR CHOICE PLEASE, NUMBER KEY "1" or "2"
```

Note: This program will work with a PC which has only one flexible disk drive. It can easily be modified for machines having two such drives to speed up the disk copying process.

5.2.10 F8: Copy Shot File

Main Menu key F8 loads the Shot File program, as did the F4 and the F6 keys. Referring to the Shot File menu (fig. 15), you can select option F8 in this program if you want a copy of the Shot File.

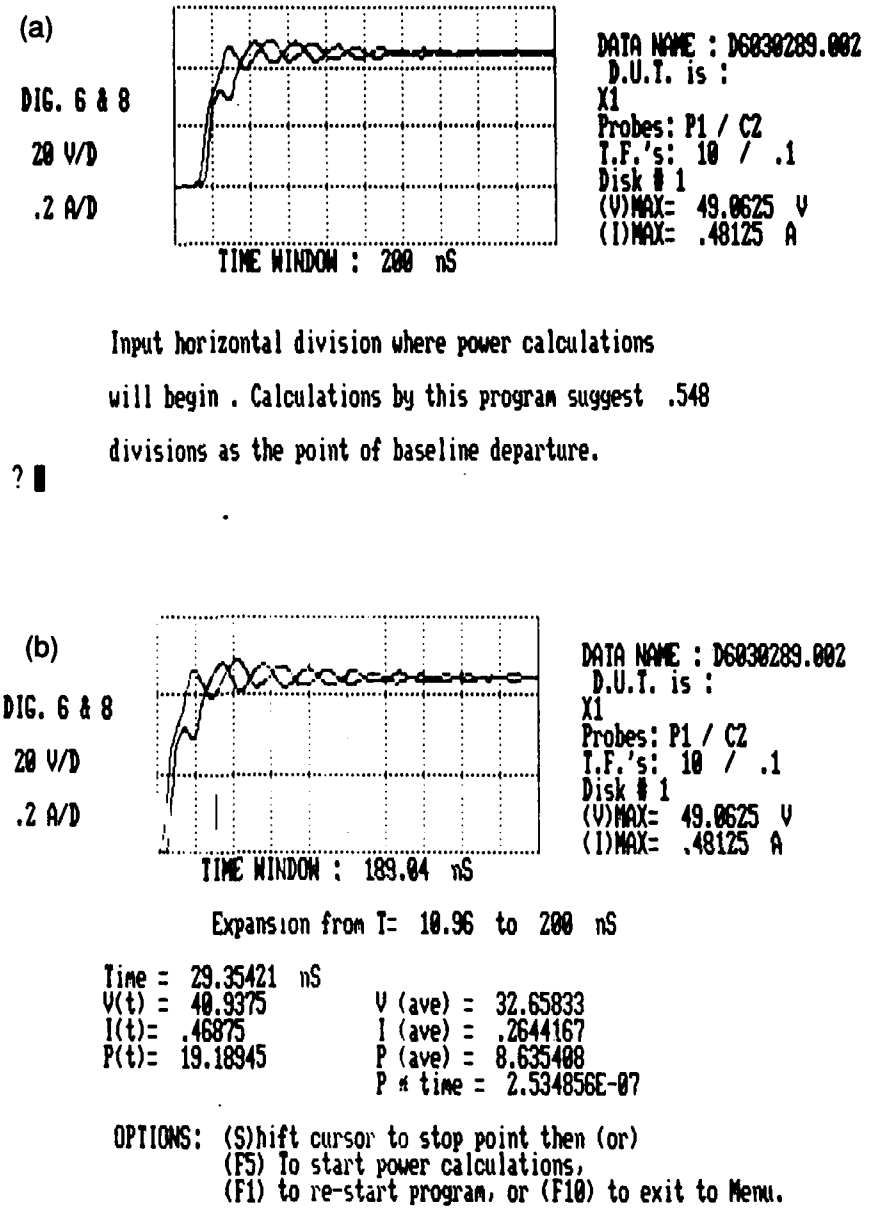
This routine is straightforward in that it will cause the Shot File (file name: SHOT.FIL) to be copied to the diskette in drive A whenever it is told to do so. As long as this diskette has been formatted, the program will write the file.

Note: If a file with the name "SHOT.FIL" already exists on the diskette, this program will write over it. This overwriting feature has a positive aspect to it. If you reserve one diskette to act as the copy device for the Shot File, it will be updated every time you choose to make a copy. That is, as the Shot File increases in size with time, so would the copy. Care should be taken that the file size does not exceed the disk capacity. A warning is provided by the program when the file size nears this point. The program ends when the option to return to the 7912 menu is selected.

5.2.11 F9: Power Computation

The last option in the 7912 menu program provides for the mathematical processing of data collected through these programs. If you select this option, a program is loaded into the PC memory which will calculate the product of any pair of voltage and current waveforms. The steps to this program are as follows. (1) A directory of data waveforms is created for the selected disk (or diskette) and presented on the monitor. (2) The selected pair of waveforms is presented on the screen as seen in figure 20(a), scaled to read as voltage and current. (3) The program calculates an estimate of where in time the waveforms begin, that is, depart from 0 V and 0 A. You are prompted to select a horizontal division point at which the power calculations should begin. The value presented on the monitor by the program is a suggested value. Please note: If the waveforms do not depart from zero at very nearly the same time, this program should not be used. (4) The monitor screen will blank and only those portions of the waveforms which occur after the selected starting time are presented as in figure 20b. Options are presented to shift the screen cursor (S), return to the beginning of the program (F1), start the power calculations (F5) or return to the Main Menu (F10). If you select the F5 key, a cursor will appear on the screen at the far left of the waveforms, and the instantaneous values of the voltage and current will be printed on the screen along with their product (instantaneous power). The keyboard cursor keys are active in this

Figure 20. Initial graphic presentation for (a) power computation program and (b) graphic presentation of power computations.



program. Pressing the right arrow key will cause the cursor to move to the right (later in time) and the instantaneous screen values of voltage, current, and power are updated to reflect the values found in the waveforms. Each time the cursor is moved, these values are updated. The parameters labeled V (avg), I (avg), P (avg), and P * time are not seen on the screen until the F5 key is pressed. In the example of figure 20b, where the time window has been expanded from 200 to 189 ns by the program, the cursor may be seen as the straight vertical line between the second and third horizontal divisions. The instantaneous time at this point is 29.35 ns as measured from the starting point in the calculations and presented in the lower left column of the figure. The

instantaneous voltage (V), current (I), and power (P) are also listed in this column.

Pressing the F5 key with the cursor at the position described above causes the parameters seen in the lower right column to appear on the screen. These are voltage (V), current (I), and power (P) as averaged (avg) over the time period between the beginning of the calculations and the present cursor postion. If the cursor is moved either left or right, these values are erased from the screen since they are no longer valid. Pressing the F5 key again will cause updated calculations of the average values to appear. The last parameter in this column is the energy, in joules, calculated from the average power times the interval of time.

Other programs for waveform analysis in device damage testing are available.[2] These programs, written in PASCAL, can be reproduced by interested users; they are not available on disc.

5.2.12 F10: Return to DOS

This option returns the PC to DOS control. Please note: HDL users might not see this option. Instead, the option to return to the opening menu of section 5.2.1 will be seen.

6. Device Damage Testing (DDT)

The test setup for the DDT efforts is shown in figure 1. The 7912AD digitizers, with 7A26 plug-ins, will conservatively measure the response of devices with rise times of 5 ns (5×10^{-9} s). Faster rise times can be recorded by using type 7104 oscilloscopes and electronic A/D cameras, which are present in HDL's instrument inventory. These oscilloscopes, when used with the 7A29 plug-in, are capable of a 350-ps (0.35×10^{-9} s) rise time and will conservatively measure 1-ns rise-time device responses.

The second input to the 7A26 plug-ins is for a timing marker. It is necessary to know the relationship in time between the voltage response (digitizer 6) and the current through the DUT (digitizer 8).

The test setup and the sequence of operation are as follows:

(1) The pulse testing of the DUT begins when the pushbutton of the Hewlett Packard (HP) model 8012A is depressed. This generator (G1) output initiates pulses for the other generators, G2 (Data type 101) and G3 (Velonex type 360). This three-generator system is necessary because of the importance of knowing the time relationship between the two DUT re-

[2] *Jeff Falter, Waveform Analysis for the IBM-PCs, Harry Diamond Laboratories, HDL-TM-88-7 (May 1987).*

sponses (current and voltage) that will be recorded by the digitizers. This will be explained after the sequence of operation.

(2) The number 1 output of G1, in addition to triggering generator G2, also triggers the time bases (7B90P) of the digitizers. The number 2, or main output of G1, is delayed (variable delay) relative to the trigger pulse (OUTPUT 1). The width of this main output pulse determines the width of the output of G3, which is the generator which actually drives the DUT.

(3) The G2 output is adjusted to produce a minimum width pulse, approximately 20 ns (20×10^{-9} s) at the top. This pulse is "square," with rise and fall times of approximately 5 ns (5×10^{-9} s), and is fed to the channel 1 inputs of both 7A26 vertical amplifiers. This pulse serves to correlate the time relationship between the outputs of the two digitizers, as will be explained shortly.

(4) The G3 generator produces a pulse across the load (or DUT). The amplitude of this pulse is determined by a manual control on the generator while the pulse width is, as previously described, determined by the G2 generator. With the application of this pulse, the voltage across the load (or DUT) and the current through it are sensed by probes and coupled to the channel 2 inputs of the digitizers.

(5) The digitizers receive three inputs each, slightly staggered in time. The G1 number 1 output arrives first, at each of the 7B90P time bases' external trigger input ports. The time bases respond by causing an operation to take place within each of the digitizers' scan converter tubes* which is analogous to a scanning beam in an oscilloscope beginning to sweep across its CRT at the 0-V level.

The next arrival is the G2 output, which hereafter will be called the timing marker. The entire time that this timing marker is present at the digitizer channel 1 inputs (~20 ns), there are no inputs to the No. 2 channels. The vertical amplifiers are in the "ADD" mode, but there is, at this time, nothing to add (i.e., only one input). The timing markers will have completed their transitions from zero to peak to zero, before the "data" arrive from the probes. When the vertical amplifiers are placed in the ADD mode, the soon-to-arrive data and the timing markers will appear together in the outputs of the digitizers.

Figure 21 is an illustration of the outputs of the digitizers under these conditions. The narrow pulses represent the timing markers, while the long "square" pulses replicate the voltage and current responses of the load or DUT.

See the Tektronix 7912AD manual for a complete description of these events.

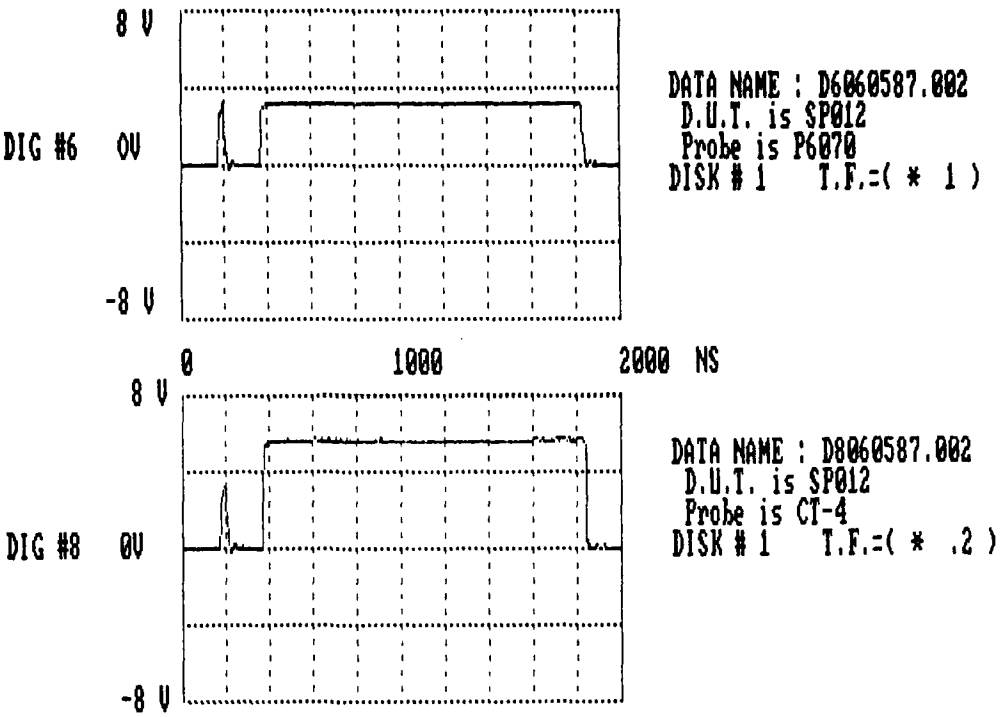


Figure 21. A representation of waveforms for device damage testing.

It is important to know the relationship in time between the voltage and current responses. This time difference, $\delta(T)$, must be known if the voltage and current are to be properly correlated (e.g., for computation of pulse power). It is possible to observe the $\delta(T)$ of the measurement system by applying a short pulse to a passive device which simulates the load or DUT. The responses seen on each digitizer, representing the current and voltage from the passive (substitute) device, would appear at slightly different times, although both digitizers were adjusted for the same time per division. This is due to differences in response times of the voltage compared to the current probe, in cable lengths between the probes and digitizers, and within the time base circuitry in which one unit might cause the scan converter to begin sweeping before the other.

These timing differences may be compensated for by delay matching the probes and their associated cables and horizontally shifting one (or both) of the digitizer waveforms using the 7B90P time base position control. This position control provides horizontal movement (time) of the waveform for approximately 15 to 20 percent of the current total time window. The voltage and current responses could then be visually adjusted until they appeared to be occurring simultaneously. Data taken immediately would most likely be trustworthy but what if something goes wrong? If any of the controls which affect the horizontal position of either waveform (such as the 7B90P **Position**, **Mode**, or **Source** controls) are disturbed, the timing relationship of the voltage and current responses is no longer valid, and later computation of pulse power would be erroneous if this shift were not detected.

The timing markers prevent this possible error. Rather than carrying out the discussed alignment procedure whenever data are to be collected or the sweep rate is changed, the pulse from generator G2 is continually applied to the channels 1 of the vertical amplifiers. The device responses (voltage and current) to the pulse of G3 (Velonex) are fed to the channels 2 and are internally added (7A26 mode switch in position ADD) to the timing signals of G2. The variable delay of G2 allows this calibration (or timing) pulse to appear some time after the beginning of the horizontal traces, and the variable delay of G1 allows the device responses to appear some time after the calibration pulse (as previously shown in fig. 19). The time differential $\delta(T)$ may or may not be set to zero.

For work at sweep rates less than 0.5 s/div, a shorter pulse than obtainable from either G1 or G2 would be desirable as input to channel 1. Whatever width timing pulse is used, it must not be present in the data for at least one-half division of the employed time window. The data collection program (step 11, section 5.2.4) treats this length of time as representing 0 V or the baseline. If the timing pulse is present, the data will not be valid.

7. Modifications and Additional Programs

It would be desirable to add certain routines to the existing programs. For example,

(1) Basic language computer coded tables were developed for the HDL MODAS software; these tables list the optimum intensity settings versus sweep speeds for the digitizers and could be included in this data acquisition program as they were for MODAS. The intensity settings for the digitizers could be set under program control as a function of the horizontal sweep speed selected by the operator.

(2) A table of probes with serial numbers and transfer functions could be created and made part of the data collection program. When the operator inputs a specific probe, this table would be consulted and the appropriate transfer function would be logged with the data. This would lessen the probability of error in the transfer function and probe type.

The program, with the mentioned table, could be modified to present the options* below:

DDT Probe Selection.—Select a probe type for digitizer #6

1. P6051 (SN8)

2. P6051 (SN31)

**Not necessarily actual probe model numbers.*

3. P6059 (SN42)

4. P6903 (SN6)

5. P8942 (SN91)

6. Other

If the "other" option were selected, the request for a transfer function and serial number would appear. The process would be repeated for the other digitizer.

8. Commercial Sources for Hardware and Software

Tektronix, Inc., of Beaverton, OR, sells a commercial package of hardware/ software for the control of instruments through the IEEE Standard 488 General Purpose Instrument Bus (GPIB). GURU is an acronym for GPIB Users Resource Utility.

The GPIB control board in the PC and the bus itself were purchased from National Instruments, of Austin, TX. This manufacturer also provided software for instrument control.

The GURU software is primarily designed as an aid in the use of Tektronix equipment although provisions are made for other manufacturers such as Hewlett-Packard. The National Instruments package is nonspecific. Both manufacturers provide manuals for package implementation with the IBM-PC computer. Two of the programs in this manual use parts of the software from National Instruments and Tektronix. The Tektronix software uses several routines that are also found in the National Instruments package.

The National Instrument files include an interpreter for interfacing the IBM BASICA computer language to the GPIB command structure and a file for configuring the system. The configuration program is resident on the hard disk in the PC and is referenced by the computer each time the system is operated.

The manuals provided by these manufacturers would make excellent reading for anyone interested in understanding the GPIB and its application.

If it should become necessary to replace one of the digitizers, the software will require slight modification. For in-house (HDL) use, there is a routine, transparent to the operator, resident on the hard disk in a directory named "GURU." This software (copyrighted by National Instruments, Inc.) must be used if

either, or both, of the digitizers is replaced. This change may only be done while the computer is under DOS control. To implement a change, use the following steps:

(1) From one of the DDT programs in IBM-BASICA, strike the CTRL/BREAK keys, enter the word `System` and then press the return key. The screen should show `C:\GURU`. If not, type `CD\GURU`. The `C:\GURU` response should appear.

(2) Type `IBCONF` and you should soon see the National Instruments logo on the screen. The program will scan a file on the hard disk (GPIB.COM) and prompt `Press any key to continue` when it is finished.

(3) The program is well documented and easy to follow. If you changed a digitizer, use the cursor keys (as instructed in the program) to highlight the name of the removed digitizer. Do *not* change this name.

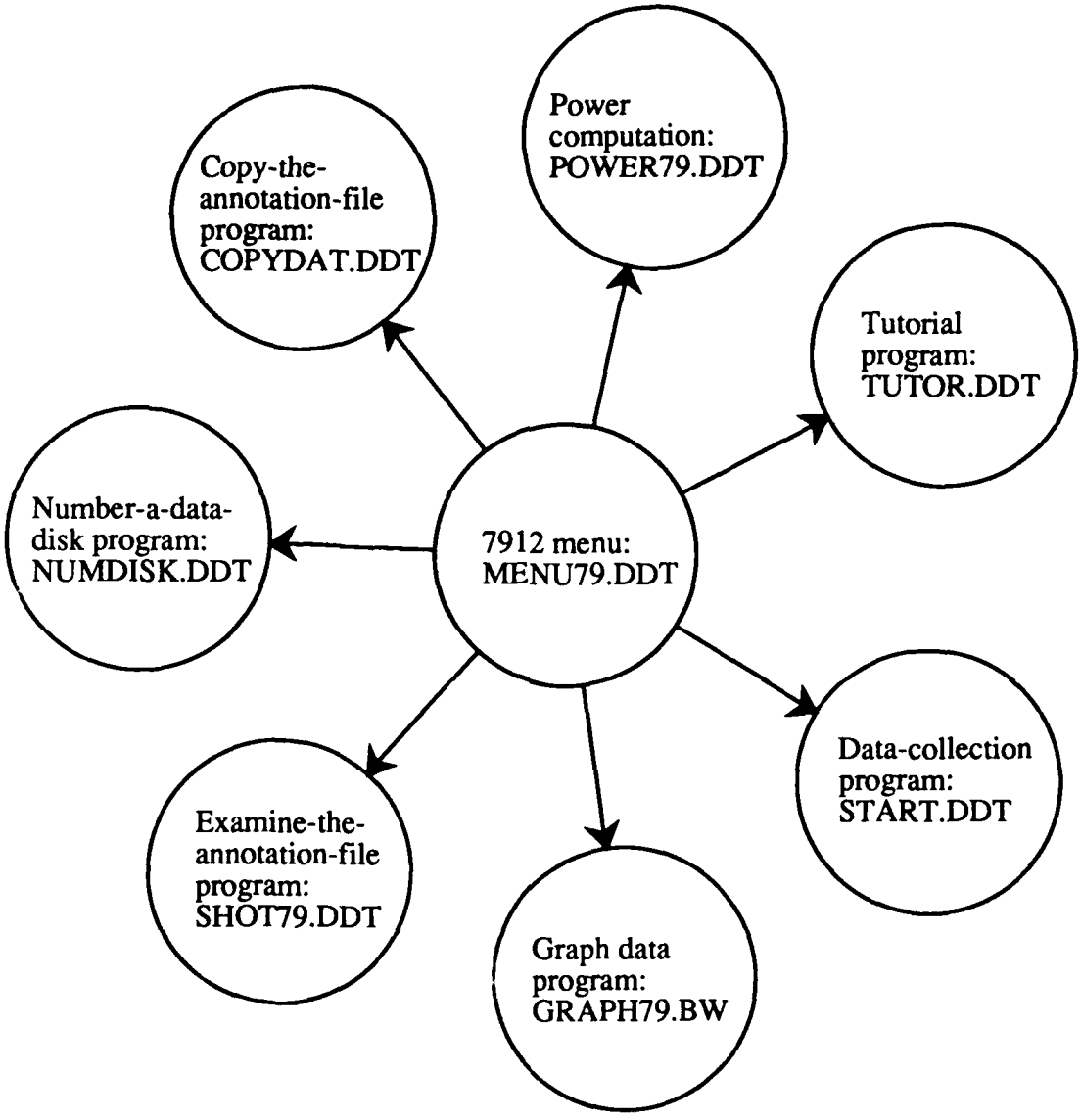
(4) Press the F8 (Edit) key. The screen will then list eight attributes of this particular digitizer. It is only necessary to change the primary GPIB address. This must be a number between 0 and 30, which is selected (as shown on the screen) by incrementing either a right or left arrow key.

(5) With the address changed as required, select F9 to return to the Map. Change the other digitizer if necessary.

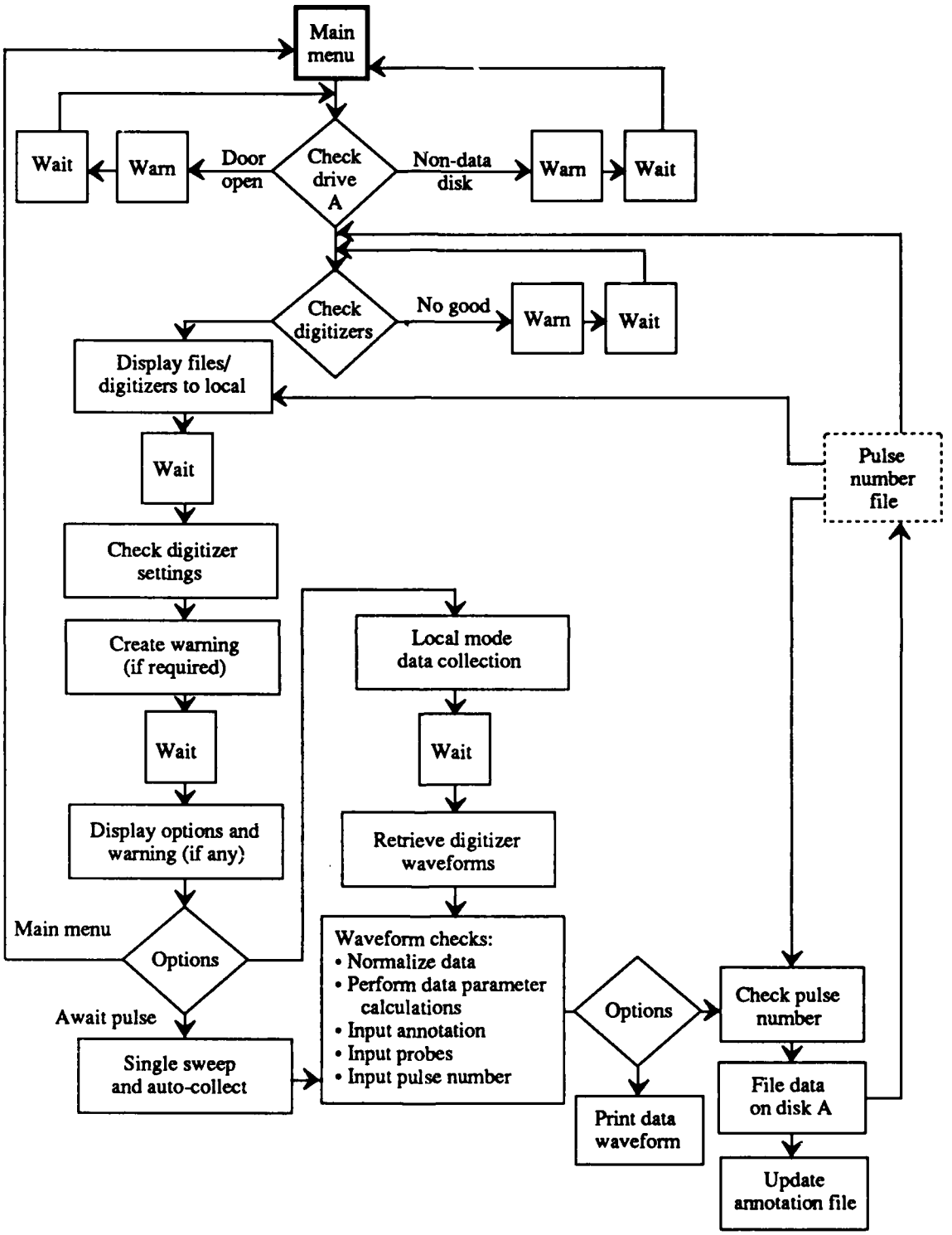
(6) When the changes are complete strike the F9 (Exit) key. Answer "`Y`" for "yes" to the "`SAVE changes?`'query. The GPIB.COM file will then receive the new values.

(7) Before the changes can be implemented, the computer must be rebooted as is shown on the screen. This is done by pressing the Ctrl, Alt, and Del keys at the same time.

Appendix A.—Interrelationship of Programs



Appendix B.—Functional Chart for Data Collection Program



Appendix C.—Menu Program

```
10 REM .....PROGRAM NAME: 'MENU79.DDT' ....15 MAY 87 .....JJL
20 REM ..... last revision was : 21-jan-88, jjl
30 REM .....from here, one may branch to any Device Damage Testing program.
40 REM
50 REM
60 REM
70 REM
80 SCREEN 0,0:KEY OFF: SCREEN 2,0
90 CLS:SCREEN 0,2:COLOR 15,7,8:CLS
100 REM
110 REM
120 REM
130 REM
140 PRINT:PRINT "      DDT  MENU for using the 7912 Transient Digitizers  jjl/MAY87
150 PRINT "  .....
160 PRINT "  USE A FUNCTION KEY FOR YOUR CHOICE OF ONE OF THE BELOW
OPTIONS...
170 PRINT:CLEAR
180 FOR N=1 TO 10:KEY(N) ON:NEXT N
190 PRINT "   F1 ..... A TUTORIAL ON THESE PROGRAMS
200 PRINT
210 PRINT "   F2 .....DATA COLLECTION  PROCEDURE
220 PRINT
230 PRINT "   F3 .....GRAPH DATA STORED ON DISC
240 PRINT
250 PRINT "   F4 .....REVIEW THE 'SHOT FILE`
260 PRINT
270 PRINT "   F5 ..... NUMBER (OR CHECK) THE DATA FLOPPY DISC
280 PRINT
290 PRINT "   F6 ..... SEARCH FOR A DATA FILE
300 PRINT
310 PRINT "   F7 ..... MAKE A COPY OF A DATA DISC
320 PRINT
330 PRINT "   F8 .....  MAKE A COPY OF THE 'SHOT FILE`
340 PRINT
350 PRINT "   F9 .....  POWER CALCULATIONS
360 PRINT
370 PRINT "   F10 .....  RETURN TO THE MAIN MENU
380 ON KEY(1) GOSUB 490
390 ON KEY(2) GOSUB 500
400 ON KEY(3) GOSUB 510
410 ON KEY(4) GOSUB 520
```

```
420 ON KEY(5) GOSUB 530
430 ON KEY(6) GOSUB 540
440 ON KEY(7) GOSUB 550
450 ON KEY(8) GOSUB 540
460 ON KEY(9) GOSUB 560
470 ON KEY(10) GOSUB 580
480 GOTO 380
490 GOSUB 610:CHAIN "TUTOR.DDT"
500 GOSUB 610:CHAIN "START.DDT"
510 GOSUB 610:CHAIN "GRAPH79.BW"
520 GOSUB 610:CHAIN "SHOT79.DDT"
530 GOSUB 610:CHAIN "NUMDSK79.DDT"
540 GOSUB 610:CHAIN "SHOT79.DDT"
550 GOSUB 610:CHAIN "COPYDAT.DDT"
560 GOSUB 610:CHAIN "POWER79.DDT"
570 REM
580 GOSUB 610:SHELL"CD\":CHAIN "CHOICES.BAS"
590 REM
600 GOSUB 610:SYSTEM
610 CLS:FOR N=1 TO 10:KEY(N) OFF:NEXT N:RETURN     'turn keys off
620 END
630 REM ..... MENU79.SUB.....
640 CLS
650 PRINT:PRINT "   HOUSE-KEEPING ..... ONE MOMENT PLEASE ....."
660 REM
670 REM ..... purpose: find all 7912 files on a disk and make a directory
680 REM ..... 7912 files begin with 'd6' or d8, but are filed as sets
690 REM
700 SHELL "C:"
710 CLEAR :DIM A$(250),F$(250), WFM%(5),DR$(80)
720 REM
730 KB$="A"         'change this letter to change drive searched
740 ON ERROR GOTO 1010
750 CHDIR "C:\GURU"
760 CHDIR KB$+":\"
770 LET DR$="dir "+KB$+": |sort>c:sort79.dir"
780 REM
790 SHELL DR$
800 SCREEN 0,0:SCREEN 2,0:KEY OFF
810 CLS:SCREEN 0,2:COLOR 15,7,8
820 CLOSE #1
830 CNF=1
```

```
840 OPEN "c:sort79.dir" FOR INPUT AS #1
850 FOR N=1 TO 250
860 IF EOF(1)= -1 THEN 910
870 INPUT #1,B$
880 IF MID$(B$,1,2)="D6" THEN LET F$(CNF)=MID$(B$,1,12)
890 IF MID$(B$,1,2)="D6" THEN LET CNF=CNF+1
900 NEXT N
910 CLOSE #1
920 REM
930 OPEN "C:FILES79.DIR" FOR OUTPUT AS #1
940 WRITE #1,CNF
950 CNF=CNF-1
960 FOR N=1 TO CNF
970 WRITE #1,F$(N)
980 NEXT N
990 CLOSE #1
1000 GOTO 60
1010 REM ..... examine error
1020 CLS
1030 IF ERR=71 THEN PRINT "  There should be a DDT data disk in drive 'A' "
1040 PRINT
1050 IF ERR=71 THEN PRINT "  Please check drive 'A'; hit any key when done"
1060 PRINT
1070 IF INKEY$="" THEN 1070
1080 RESUME 10
```

Appendix D.—Tutorial Program

```
10 CLS:PRINT "   PROGRAM NAME : 'TUTOR.DDT'     PAGE 1 of (10)  MAY 87 /jjl
20 PRINT
30 CLEAR:KEY OFF
40 SCREEN 0,1
50 COLOR 15,2,8
60 PRINT "     These programs were written to control and file data from
70 PRINT "   two type 7912AD (Tektronix) transient digitizers. They are
80 PRINT "   numbered #6 and #8 on the front panels.
90 PRINT:PRINT
100 PRINT "     The digitizers are controlled by an IBM PC-XT computer through
110 PRINT "  the GPIB ( general purpose instrumentation bus ) and a National
120 PRINT "  Instruments GPIB control card installed within the computer.
130 PRINT "  The digitizers and computer are linked by the GPIB multiconductor
140 PRINT "  cable. At this time ( April 1987 ) the computer and digitizers may
150 PRINT "  be separated physically by no more then the length of this cable,
160 PRINT "  approximately three meters.
170 PRINT:PRINT
180 PRINT "     The programs are written in the BASIC computer language using
190 PRINT "   IMB advanced basic or BASICA Ver 2.1 . They are stored on the
200 PRINT "   hard disc ( drive: C ) of the Branch 21400 IBM PC with the HDL
210 PRINT "   Bar Code Property # 52508. Copies are present on floppy discs.
220 PRINT
230 PRINT "   ....."
240 GOSUB 2510
250 IF CH$="P" OR CH$="p" THEN GOTO 10
260 CH$=""
270 CLS:PRINT "                              TUTOR.DDT  page 2 of (10
280 PRINT:PRINT:PG=2
290 PRINT "     The programs are what is called  'menu driven'. From the
300 PRINT "   program named 'MENU' you may direct the computer to load any
310 PRINT "   of the other programs currently in use. These programs offer
320 PRINT "   the options of : (1) collecting and filing digitizer
330 PRINT "   response data, (2) retrieving previously filed data,
340 PRINT "   (3) reviewing something called a 'shot file', and
350 PRINT "   (4) signal processing (FFT,integration,etc) of the data.
360 PRINT
370 PRINT "    The 'shot file' is designed to keep track of every recorded
380 PRINT "   data files. These data files, which will rapidly grow in
390 PRINT "   number, will be stored on floppy discs.
400 PRINT
410 PRINT "      The 'shot file' will tell you the following :
420 PRINT
430 PRINT "     (1) the name of the data file and its resident disc number
```

```
440 PRINT "      (2) the date and time when the data was filed
450 PRINT "      (3) any descriptive annotation supplied at filing time
460 PRINT "      (4) the Device Under Test (DUT) for any data filed
470 PRINT "....."
480 GOSUB 2510
490 REM
500 IF CH$="p" OR CH$="P" THEN GOTO 10
510 CH$=""
520 CLS:PRINT "                              TUTOR  page 3 of (10)
530 PRINT:PRINT:PG=3
540 PRINT "    The shot file should always be resident on the IBM PC hard
550 PRINT "  disc. In this way, you should alway be able to find the data
560 PRINT "  you wish to review.
570 PRINT:PRINT
580 PRINT "      A CAUTION:
590 PRINT "      IT WOULD BE A GOOD IDEA TO COPY THE SHOT FILE TO A
600 PRINT "      FLOPPY DISC ON A REGULAR BASIS. AN OPTION EXISTS WITHIN
610 PRINT "      THIS PROGRAM FOR THAT PURPOSE.
620 REM
630 PRINT:PRINT "      Some hints on how to search the shot file
640 PRINT:PRINT
650 PRINT "      Every time data was collected through the DDT
660 PRINT "    programs, the opportunity was present to file descriptive
670 PRINT "    annotation with the data. If this annotation was done, the
680 PRINT "    'shot file` contains a copy of whatever text was input.
690 PRINT
700 PRINT:GOSUB 2510
710 IF CH$="p" OR CH$="P" THEN GOTO 260
720 CH$=""
730 CLS:PRINT "                              TUTOR  PAGE 4 of (10
740 PRINT:PRINT:PG=4
750 PRINT "    This program, loaded with the F4 key in the main menu,
760 PRINT "  is useful in that it will allow you to conduct a search
770 PRINT "  through all of this annotation for each occurance of a given
780 PRINT "  word or phrase. For instance, you might wish to know what
790 PRINT "  data was filed for a particular device. If that device name
800 PRINT "  was input during the data annotation, then you can find the
810 PRINT "  file name and disc number with this program.
820 PRINT
830 PRINT "    The key is to input exactly the same text, or even part
840 PRINT "  of the text. As an example, if you input 'device 104` and
850 PRINT "  the original entry was 'dev 104` , the search will be fruitless.
860 PRINT "  If however, you input only the numbers ' 104 ` then you would
870 PRINT "  be sucessful. It is best to be concise.
```

```
880 REM
890 PRINT:PRINT "     The next page contain information on the data collection
900 PRINT "       program ( F2 on the MENU program key ).
910 PRINT:PRINT "     ....."
920 GOSUB 2510
930 IF CH$="p" OR CH$="P" THEN GOTO 510
940 CH$=""
950 CLS:PRINT "                                TUTOR  PAGE 5 of (10)
960 PRINT:PG=5
970 PRINT "      The data collection program is designed to obtain two
980 PRINT "   waveforms from the digitizers via the GPIB bus as previously
990 PRINT "   described. There are many error traps in this program.
1000 PRINT "   As an example, when the program is first loaded into memory
1010 PRINT "   with the (F2) key, the first lines of code in the program will
1020 PRINT "   check to see that there is a valid floppy disc in drive 'A` and
1030 PRINT "   that the drive door is closed. If necessary, the program waits
1040 PRINT "   for you to take corrective action in either or both cases.
1050 PRINT
1060 PRINT "      If the drive 'A` door is closed and a valid floppy is present
1070 PRINT "   this check is transparent to the operator. A valid disc is one
1080 PRINT "   which has been numbered ( the numbering program is loaded by the
1090 PRINT "   (F5) key in the MENU program ). This numbering of discs will be
1100 PRINT "   quite useful in the future, when enough data has been collected
1110 PRINT "   to form a data base. Each time waveforms are collected and
1120 PRINT "   filed, this number goes with the data. If the data is graphed
1130 PRINT "   the disc number appears with the waveforms. In this manner, the
1140 PRINT "   data may easily be retrieved at a future date.
1150 PRINT:GOSUB 2510
1160 IF CH$="p" OR CH$="P" THEN GOTO 720
1170 CH$=""
1180 CLS:PRINT "                                TUTOR    page 6 of (10)
1190 PRINT:PRINT:PG=6
1200 PRINT "      There is another 'menu` within the data collection program.
1210 PRINT "   This menu offers choices of how you wish to proceed, including
1220 PRINT "   returning to the Main menu. You may choose to digitize data or
1230 PRINT "   or keep the digitizers in the local mode, where you may use
1240 PRINT "   them in any way you choose. Until you are prepared to proceed
1250 PRINT "   the computer will wait indefinitely. If you choose to digitize,
1260 PRINT "   the computer will transfer the resulting waveform to memory.
1270 PRINT
1280 PRINT "      With the completion of the digitization, the computer will
1290 PRINT "   ask you for a 'shot number` for the data. This is a three digit
1300 PRINT "   number between ( 001 ) and ( 999 ). This is the only input you
1310 PRINT "   need make for the file name of the data. The computer will find
```

```
1320 PRINT "   the date within memory, and form the file names from the
1330 PRINT "   characters 'D6` ( for digitizer #6 ) and 'D8` ( for
1340 PRINT "   digitizer #8 ). An example would be 'D6070487.001` . This
1350 PRINT "   would be the waveform from digitizer #6, July 4,1987 , shot #1.
1360 PRINT
1370 GOSUB 2510
1380 IF CH$="p" OR CH$="P" THEN GOTO 940
1390 CH$=""
1400 CLS: PRINT "                              TUTOR     page 7 of (10)
1410 PRINT:PG=7
1420 PRINT "     At the beginning of the program was a routine which examined
1430 PRINT "   the floppy disc. If any data bearing the current date had been
1440 PRINT "   found on the disc, the file names would have been printed for
1450 PRINT "   you. A routine in the latter part of the program should prevent
1460 PRINT "   the use of the same pulse number twice on any one day.
1470 PRINT
1480 REM
1490 PRINT
1500 PRINT "     The next stage of the program requires the computer to
1510 PRINT "   perform several mathematical operations on the data. These
1520 PRINT "   are (1) the maximum of each waveform, (2) the minimum of each
1530 PRINT "   wavform and (3) the time at which each maximum occurs.
1540 REM
1550 PRINT:PRINT
1560 PRINT "   This procedure takes some time, but is useful in later data
1570 PRINT "   analysis. The time to complete an entire data acquisition cycle
1580 PRINT "   is approximately six (6) minutes. The computational time will
1590 PRINT "   be  reduced when the program is compiled. This compilation
1600 PRINT "   will take place when the final ( approved ) version of the
1610 PRINT "   program is complete.
1620 PRINT:GOSUB 2510
1630 IF CH$="p" OR CH$="P" THEN GOTO 1170
1640 CH$=""
1650 CLS:PRINT "                               TUTOR   page 8 of (10)
1660 PRINT:PG=8
1670 PRINT "     The program will ask for the inputs on probe transfer function
1680 PRINT "   (T.F.),probe names, the device under test and any annotation you
1690 PRINT "   might care to have accompany the data. An example T.F. would be
1700 PRINT "   ( .2 ) for a CT-1 current transformer. The voltage presentation
1710 PRINT "   could be multiplied by this value to yield a waveform that is
1720 PRINT "   representative of the current in amperes.
1730 PRINT
1740 PRINT "     The device under test ( D.U.T.) input will be important in
```

```
1750 PRINT "  later searches of the 'shot file`. Up to 255 characters may
1760 PRINT "  be input for this name, but brevity is important. See the 'shot-
1770 PRINT "  file` discussion earlier for more details.
1780 PRINT
1790 PRINT "   The annotation input is for your convenience. It provides a place
1800 PRINT "  for any 'notes` you may care to make. The limit is 255 characters.
1810 REM
1820 PRINT
1830 PRINT "   After these inputs have been made, the program will present them
1840 PRINT "  for your approval. You will then have the option of changing all
1850 PRINT "  or any of them. When they appear as you want them, you have the
1860 PRINT "  option to continue to the next step.
1870 PRINT
1880 GOSUB 2510
1890 IF CH$="p" OR CH$="P" THEN GOTO 1390
1900 CH$=""
1910 CLS: PRINT "                          TUTOR    page 9 of (10)
1920 PRINT:PRINT:PG=9
1930 PRINT "     The waveforms, annotation and parameters will then be
1940 PRINT "  presented on the computer display terminal. To make a hard
1950 PRINT "  copy of this display on the Epson printer :
1960 PRINT
1970 PRINT "  (1) move the paper advance wheel to the next sheet.
1980 PRINT
1990 PRINT "  (2) press the ( ^ ) and (PrtSc) keys at the same time
2000 PRINT
2010 PRINT "       A hard copy will be printed for you.
2020 PRINT:PRINT
2030 PRINT "   If you do not want a hard copy, hit any key ( other than
2040 PRINT "   the print screen keys ) when the graph is complete. This action
2050 PRINT "   will cause the data to be filed and the program to return to
2060 PRINT "   the beginning, where a routine will show you that the data was
2070 PRINT "   filed. You may then collect more data or just step through
2080 PRINT "   the program to the 'menu` where you may exit.
2090 PRINT:PRINT
2100 GOSUB 2510
2110 IF CH$="p" OR CH$="P" THEN GOTO 1640
2120 CH$=""
2130 CLS:PRINT "                          TUTOR    page 10 of 10
2140 PRINT:PG=10
2150 PRINT "     You may graph stored data at any time by returning to the
2160 PRINT "  Main Menu and selecting the ( F3 ) key. It is labeled in the
2170 PRINT "  program as 'Graph data stored on disc`.
```

```
2180 PRINT
2190 PRINT "    In addition to the other function previously mentioned
2200 PRINT "  one may search for a data file with the program loaded through
2210 PRINT "  the ( F6 ) key in the Main Menu. This program will tell you
2220 PRINT "  on which disc the data is located in addition to other
2230 PRINT "  information which may prove useful.
2240 PRINT
2250 PRINT "    The ( F7 ) key in the main menu calls a program which will
2260 PRINT "  make a copy of a data disk. A data set ( two waveforms, one
2270 PRINT "  from each digitizer ) is approximately 2300 bytes in length.
2280 PRINT "  A dual density, dual sided floppy disc should hold 75 such
2290 PRINT "  sets, conservatively. Prudence dictates that a back-up record
2300 PRINT "  of the data be maintained. When you have as much data as you
2310 PRINT "  want on a floppy, use the copy ( F7 ) option.
2320 PRINT
2330 GOSUB 2510
2340 IF CH$="p" OR CH$="P" THEN GOTO 1900
2350 CH$=""
2360 PRINT "                    J. Loftus Br 21400
2370 PRINT "                    EMEL  HDL  06-MAY-87
2380 PRINT:PRINT
2390 REM
2400 REM
2410 PRINT:PRINT " CHOICES: (1)  return to main menu
2420 PRINT "        (2)  goto 'START' program for data collection
2430 PRINT "        (3)  repeat this tutorial
2440 INPUT CH%
2450 IF CH%=1 THEN LOAD "menu.ddt",R
2460 IF CH%=2 THEN LOAD "start.ddt",R
2470 IF CH%=3 THEN GOTO 10
2480 BEEP: PRINT "                NUMBER KEY (1) , (2) , or (3) PLEASE
2490 COLOR 15,1:PRINT CH%;" not acceptable; try again please.
2500 COLOR 15,4,1:GOTO 2400
2510 PRINT "  Input 'n' (next page) 'p' (previous page) or 'm' (main menu)
2520 CH$=INKEY$:IF CH$="" THEN 2520
2530 REM
2540 IF CH$="M" OR CH$="m" THEN LOAD "MENU.DDT",R
2550 IF CH$="n" OR CH$="N" THEN RETURN
2560 IF CH$="p" OR CH$="P" THEN RETURN
2570 IF CH$<>"p" OR CH$<>"P" THEN PRINT "  'n'  'p'  or  'm' please
2580 IF CH$<>"p" OR CH$<>"P" THEN PRINT
2590 IF CH$<>"p" OR CH$<>"P" THEN GOTO 2510
2600 RETURN
```

Appendix E.—Data Collection Program

```
10 ' ..... APPENDIX E  ( START.DDT) ..... HDL /jjl
20 '.....last mod 01-mar-89
30      ' The 7912 data collection program for Device Damage Testing
40 '
50 CLS:SCREEN 0,2 :COLOR 10,1,7:ON ERROR GOTO 0:CLEAR:CLS
60      CLEAR    ,58955!        ' IBM BASICA Declarations
70 PRINT:PRINT
80 PRINT "    The 7912 data collection program for Device Damage Testing."
90 '
100 SCREEN 0,2:KEY OFF:PRINT
110 '
120 GOSUB 7430      'checks for disk number and if door to drive is open
130             ' if disk number found, it is assigned to dn%
140 '
150 PRINT "             DATA WILL BE STORED ON DATA DISK # ";DN%
160 '
170 DN6%=DN%:DN8%=DN%       ' assign a disk number for each digitizer
180 '
190 DIM WARN$(10):WARN%=1      ' string array to store warnings
200 '
210 DA$=MID$(DATE$,1,2)+MID$(DATE$,4,2)+MID$(DATE$,9,2)
220 '
230 CF6$=" DIR A:D6"+DA$+".* >FN.FIL"
240 '
250  CNF = 0 :SHELL CF6$
260 '       load Tektronix routines AFTER using  (shell).
270 REM .... routine to load necessary gpib interpretive routines
280 ' >>> program will not work without separate commercial ( you buy ) s/w.<<<
290 '
300 '    CLEAR    ,58955!        ' IBM BASICA Declarations
310 CLOSE #1:OPEN "FN.FIL" FOR INPUT AS #1
320      IBINIT1=58955!
330      IBINIT2=IBINIT1+3
340      BLOAD "bib.m",IBINIT1 ' ....file from GURU II commercial S/W.
350 '
360      CALL IBINIT1(IBFIND,IBTRG,IBCLR,IBPCT,IBSIC,IBLOC,
IBPPC,IBRNA,IBONL,IBRSC,I BSRE,IBRSV,IBPAD,
IBSAD,IBIST,IBDMA,IBEOS,IBTMO,IBEOT,IBRDF,IBWRTF)
370      CALL IBINIT2(IBGTS,IBCAC,IBWAIT,IBPOKE,IBWRT,IBWRTA,IBCMD,
IBCMDA,IBRD,IBRDA,IBSTOP IBRPP,IBRSP,IBDIAG,IBXTRC,IBRDI,IBWRTI,IBRDIA,
IBWRTIA,IBSTA%,IBERR%,IBCNT%)
380 INIT=IBINIT1+1146
390 '
400 BLOAD "bib728.m",INIT  ' ..... file from GURU II commercial software.
410 CALL INIT(ENBLK,DEBLK)
420 ' ..... read in sorted data files \ find last pulse number
430 FOR N = 1 TO 999
440  IF EOF (1) THEN 490
450 INPUT #1,LN$
460  IF MID$(LN$,1,2)="D6" THEN LET  LPN$=MID$(LN$,10,3)
```

```
980 PRINT "       If necessary, adjust the settings as required, otherwise :
990 PRINT "     ************************************************************
1000 PRINT:PRINT:PRINT "     >>>>>>>>>> HIT ANY KEY TO COLLECT DATA
<<<<<<<<<<"
1010 REM
1020 IF INKEY$="" THEN 1020
1030 REM
1040 CLS:PRINT "   The 7912 Data Collection Program     Page 2 "
1050 GOSUB 1440   'rem...routine to put settings into both digitizers
1060 GOSUB 1610   'rem...routine to set plug-ins
1070 GOSUB 2320   'rem...routine to provide branching choices
1080 REM
1090 REM
1100 REM
1110 REM
1120  '..... check for GPIB error .....
1130 REM
1140 IF IBSTA%>=0 AND BD%>=0 AND IBSTA%<&H4000 AND IBERR%<>6 THEN RE-
TURN 'no error to report
1150 COLOR 12,0,7
1160 IF BD%<0 THEN PRINT "    device not installed - use IBCONF then reboot"
1170 IF IBSTA%>0 AND IBSTA%>=&H4000 THEN PRINT "    timeout"
1180 IF IBERR%=6 THEN PRINT "    timeout"
1190 PRINT "       gpib error ";IBERR%
1200 IF IBERR%=0 THEN PRINT "     DOS error (is device installed?)
1210 IF IBERR%=1 THEN PRINT "     function requires GPIB-PC to be CIC
1220 IF IBERR%=2 THEN PRINT "    no listener on write function; is power 'on`
1230 IF IBERR%=3 THEN PRINT "    GPIB-PC not addressed correctly
1240 IF IBERR%=4 THEN PRINT "    invalid argument to function call
1250 IF IBERR%=5 THEN PRINT "    GPIB-PC not system controller as required
1260 IF IBERR%=6 THEN PRINT "    I/O operation aborted
1270 IF IBERR%=7 THEN PRINT "    non-existent GPIB-PC board
1280 IF IBERR%=10 THEN PRINT "   I/O started before previous operation complete
1290 IF IBERR%=11 THEN PRINT "     no capability for operation
1300 IF IBERR%=12 THEN PRINT "     file system error
1310 IF IBERR%=14 THEN PRINT "     command error during device call
1320 IF IBERR%=15 THEN PRINT "     serial poll status byte lost
1330 IF IBERR%=16 THEN PRINT "     SRQ stuck in on position
1340 IF HELP% THEN INPUT "[enter] to continue";A$
1350 PRINT
1360 PRINT "   STOPPING BECAUSE OF ERROR ; TAKE CORRECTIVE ACTION IF
POSSIBLE"
1370 PRINT:PRINT "    >>> HIT ANY KEY WHEN READY TO RE-START PROGRAM <<<
1380 'FOR I=750 TO 500 STEP -5:SOUND I,.5:NEXT I
1390 IF INKEY$="" THEN 1390
1400 COLOR 15,2,7:CLS
1410 GOTO 50
1420 RETURN
1430 '
1440 REM .... sub-routine to put settings into both digitizers and confirm
1450 REM
```

```
1460 PRINT:PRINT "        ..... WORKING ....."
1470 WD$="MODE TV;GRAT OFF;TV ON;XYZ OFF;DT OFF;REM OFF;OPC OFF;MAI
100;GRI 0;FOC 23;TW 100;RT 64;"
1480 REMSET$=WD$
1490 CALL IBWRT(DS%,WD$):GOSUB 1120   'write set to d6 : check error
1500 SET$="set?":CALL IBWRT(DS%,SET$):GOSUB 1120   'check set,d6 : check error
1510 RD$=SPACE$(255)      'a string to receive the settings
1520 CALL IBRD(DS%,RD$):GOSUB 1120
1530 IF MID$(RD$,1,88)=WD$ THEN PRINT "       D6 is O.K."
1540 RD$=SPACE$(255)      'use the string and reset
1550 CALL IBWRT(DE%,WD$):GOSUB 1120   'write set to d8 : check error
1560 CALL IBWRT(DE%,SET$):GOSUB 1120    'check set,d8 : check error
1570 CALL IBRD(DE%,RD$):GOSUB 1120     'read set, check error
1580 IF MID$(RD$,1,88)=WD$ THEN PRINT "       D6 is O.K."
1590 RETURN
1600 REM ..........
1610 REM ...sub-routine for plug-in settings
1620 REM ..........
1630 SET6$=SPACE$(80):SET8$=SPACE$(80)   'rem  strings for v/d and s/d
1640 GOSUB 3140  'clear digitizers
1650 PRINT:SET6$=" "
1660 REM ...next queries v/d for d6,ch1 and returns value : w/ error check
1670       WD$="vs1?;":RD$=SPACE$(15):CALL       IBWRT(DS%,WD$):CALL
IBRD(DS%,RD$):GOSUB 1120
1680 SET6$=SET6$+RD$
1690 GOSUB 3140  'clear digitizers
1700 REM
1710 REM ...next queries v/d for d6,ch2 and returns value : w/ error check
1720 REM
1730       WD$="vs2?;":RD$=SPACE$(15):CALL       IBWRT(DS%,WD$):CALL
IBRD(DS%,RD$):GOSUB 1120
1740 SET6$=SET6$+" "+RD$
1750 GOSUB 3140  'clears digitizers
1760 REM
1770 REM ...next queries time/div for d6, and returns value : w/ error check
1780 REM
1790  WD$="hs1?  <nr3>;":RD$=SPACE$(15):CALL  IBWRT(DS%,WD$):CALL
IBRD(DS%,RD$)
1800 GOSUB 1120
1810 SET6$=SET6$+" time base = "+RD$
1820 HS6$=RD$
1830 PRINT "_____"
1840 PRINT
1850 PRINT "    digitizer #6, both vertical plug-ins and time base settings :
1860 PRINT
1870 PRINT "   "; SET6$
1880 GOSUB 3140  'clear digitizers
1890 PRINT:SET8$=" "
1900 REM
1910 REM ...next queries v/d for d8,ch1 and returns value : w/ error check
1920 REM
```

```
1930      WD$="vs1?;":RD$=SPACE$(15):CALL      IBWRT(DE%,WD$):CALL
IBRD(DE%,RD$):GOSUB 1120
1940 SET8$=SET8$+RD$
1950 GOSUB 3140  'clear digitizers
1960 REM
1970 REM ...next queries v/d for d8,ch2 and returns value : w/ error check
1980 REM
1990      WD$="vs2?;":RD$=SPACE$(15):CALL      IBWRT(DE%,WD$):CALL
IBRD(DE%,RD$):GOSUB 1120
2000 SET8$=SET8$+" "+RD$
2010 GOSUB 3140  'clears digitizers
2020 REM
2030 REM ...next queries time/div for d8, and returns value : w/ error check
2040 REM
2050  WD$="hs1?  <nr3>;":RD$=SPACE$(15):CALL  IBWRT(DE%,WD$):CALL
IBRD(DE%,RD$)
2060 HS8$=RD$
2070 GOSUB 1120  'error check
2080 REM ..... next warns if sweep speeds not the same
2090 REM
2100 IF HS6$<>HS8$ THEN COLOR 15,1
2110 IF HS6$<>HS8$ THEN SOUND 40,5
2120 IF HS6$<>HS8$ THEN PRINT " >> CAUTION : SWEEP SPEEDS ARE NOT THE SAME
<<
2130 IF HS6$<>HS8$ THEN COLOR 10,1,7
2140 IF HS6$<>HS8$ THEN LET WARN$(WARN%)=" time bases settings are not equal."
2150 IF HS6$<>HS8$ THEN LET WARN%=WARN%+1
2160 IF HS6$<>HS8$ THEN LET ET$=" CHECK SWEEP RATES BEFORE DATA COLLEC-
TION "
2170 SET8$=SET8$+" time base = "+RD$
2180 PRINT
2190 PRINT "    digitizer #8, both vertical plug-ins and time base settings :"
2200 PRINT
2210 PRINT "    ";SET8$
2220 PRINT "_____________________________________________________________"
2230 REM
2240 PRINT:PRINT "    >>>>  Next page has Manual settings change option .<<<<"
2250 PRINT:PRINT "          >>>>  HIT ANY KEY TO CONTINUE  <<<<"
2260 REM
2270 REM
2280 REM
2290 IF INKEY$="" THEN 2290
2300 RETURN
2310 REM
2320 REM .....sub-routine to provide options .....
2330 REM
2340 CLS:PRINT "PROGRAM NAME : START       PAGE 3          APR86 jjl
2350 REM
2360 COLOR 15,1: PRINT:PRINT "    >>>> notes (if any) : "; ET$:ET$="":COLOR 10,1,7
2370 PRINT:PRINT:PRINT "          CHOICES AT THIS POINT :"
2380 PRINT:PRINT "    (1) Digitize data from both digitizers."
```

```
2390 PRINT:PRINT "     (2) Return to the beginning of this program ."
2400 PRINT:PRINT "     (3) Return to the main Device Damage Testing menu.
2410 PRINT:PRINT "     (4) Return to IBM DOS control of computer.
2420 PRINT:PRINT
2430 PRINT "      INPUT YOUR CHOICE AS A NUMBER KEY, '1` THROUGH '4`"
2440 REM
2450 CH$="":CH$=INKEY$:IF CH$ = "" THEN 2450
2460 GOSUB 3140:GOSUB 1120  'choice : clear digs : error chk
2470 IF CH$="1" THEN GOSUB 2610  'get single sweep data
2480 '
2490 IF CH$="2" THEN GOTO 50   'return to beginning
2500 '
2510 IF CH$="3" THEN CHAIN "MENU79.DDT"  'return to main 7912 ddt menu
2520 '
2530 IF CH$="4" THEN SYSTEM
2540 REM ..... next traps invalid input
2550 BEEP
2560 ET$="        INPUT INVALID, PLEASE USE NUMBERS '1` THRU '4`"
2570 REM
2580 GOTO 2320
2590 REM
2600 REM
2610 REM .....sub-routine to digitize and file single sweep data .....
2620 PRINT:PRINT:ET$=""
2630 REM
2640 CLS:PRINT "SINGLE SHOT DATA COLLECTION PROCEDURE FOR DEVICE DAM-
AGE TESTING"
2650 PRINT
"                                                                    "
2660 PRINT:PRINT "      The digitizers are in the LOCAL operation mode.
2670 PRINT:PRINT
2680 PRINT:PRINT "      When you have the data that you want in the"
2690 REM
2700 PRINT:PRINT "      digitizers (as seen on the digital monitor)
2710 REM
2720 PRINT:PRINT "      hit the 'y` (for yes) key.
2730 REM
2740 PRINT:PRINT "      To EXIT back to menu, hit 'n` (for no).
2750 REM
2760 WD$="grat off;tv on;mode tv;"    'be sure grat off, tv on
2770 REM
2780 GOSUB 3140   'cle.. digitizers
2790 CALL IBWRT(DS%,WD$):CALL IBWRT(DE%,WD$):GOSUB 1120  'send mess : err chk
2800 GOSUB 3140   'clear digitizers
2810 REM
2820 CALL IBLOC(DS%):CALL IBLOC(DE%):GOSUB 1120   'set both to local
2830 PRINT:PRINT
2840 PRINT "..... Input (y)  or  (n)  please."
2850 CH$="":CH$=INKEY$: IF CH$ = "" THEN 2850
2860 '
2870 PRINT
```

```
2880 IF CH$="n" THEN CH$ = "N"
2890 IF CH$="N" THEN GOTO 2320
2900 IF CH$="y" THEN CH$ = "Y"
2910 IF CH$="Y" THEN GOTO 2980
2920 COLOR 1,15:PRINT " input ( ";CH$;" ) can not be used. `y` or `n` please."
2930 PRINT ">>> HIT ANY KEY TO CONTINUE <<<"
2940 IF INKEY$="" THEN 2940
2950 COLOR 10,1,7:GOTO 2830
2960 REM
2970 REM
2980  PRINT:PRINT "       Input a file number for this data (001 to 999)
2990 IF CNF = 0 THEN PRINT "       This pulse number should be [ 001 ].
3000 IF CNF = 0 THEN GOTO 3020
3010 PRINT:PRINT " Note: the last file number found was : ";LPN$
3020 INPUT EXT$          'input file name extension ; check it is 3 chars.
3030 IF LEN(EXT$)<>3 THEN PRINT "three digits please..... ie  `007`
3040 IF LEN(EXT$)<>3 THEN 2860
3050  LET N6$="D6"+DA$+"."+EXT$
3060  LET N8$="D8"+DA$+"."+EXT$
3070 '
3080 '
3090 GOSUB 7710          ' pulse number check
3100 REM
3110 GOSUB 8490      ' ..... check intensities and time base equality
3120 GOSUB 3160      '.... get binary waveforms from digitizers
3130 REM
3140 CALL IBCLR(DS%):CALL IBCLR(DE%):RETURN   '.....to clear digitizers
3150 REM  .....
3160 REM  ..... acquire a binary waveform .....
3170 REM  .....
3180 WD$="read sc1,sc2"      ' ..... command to digs to read time bases
3190 REM
3200 CALL IBWRT(DS%,WD$):CALL IBWRT(DE%,WD$):GOSUB 1120
3210 SC1$=SPACE$(25):SC2$=SPACE$(25)
3220 CALL IBRD(DS%,SC1$):CALL IBRD(DE%,SC2$):GOSUB 1120
3230 REM
3240 REM  .....trap different times, d6 and d8 .....
3250 LET VS1=VAL(MID$(SC1$,6,6)):LET VS2=VAL(MID$(SC2$,6,6))
3260 LET HS1=VAL(MID$(SC1$,18,9)):LET HS2=VAL(MID$(SC2$,18,9))
3270 'IF HS1<>HS2 THEN STOP     ' use to stop data with unequal time windows
3280 GOSUB 3130         'clear digitizers
3290 TI$=TIME$:DA$=DATE$     '..... find time and date
3300 '
3310 WD$=" def off;dig def,<25>"     ' .... command to digitize defects
3320 CALL IBWRT(DS%,WD$):CALL IBWRT(DE%,WD$):GOSUB 1120
3330 REM GOSUB 9000   'clear digitizers
3340 WD$="def on;atc;read atc"     ' avoid the defects, average to center
3350 CALL IBWRT(DS%,WD$):CALL IBWRT(DE%,WD$):GOSUB 1120
3360 REM GOSUB 9000   'clear digitizers
3370 RDS$="":RDE$=""
3380 RDS$=SPACE$(1):CALL IBRD(DS%,RDS$):GOSUB 1120
```

```
3390 IF RDS$=CHR$(255) THEN GOSUB 1120  ' ..... something wrong ?
3400 IF RDS$<>"%" THEN GOTO 3380      ' ..... keep looking for start
3410 RDE$=SPACE$(1):CALL IBRD(DE%,RDE$):GOSUB 1120
3420 IF RDE$=CHR$(255) THEN GOSUB 1120
3430 IF RDE$<>"%" THEN GOTO 3410
3440 REM
3450 REM
3460 REM ..... determine block length .....
3470 RD$=""
3480 RD$=SPACE$(2):CALL IBRD(DS%,RD$):GOSUB 1120
3490 CT6%=0:CT6%=ASC(RD$)*256+(ASC(RIGHT$(RD$,1)))-1
3500 CLS                        ' ..... another page
3510 PRINT "        Acquiring a ";CT6%;" byte waveform from digitizer #6
3520 RD$=""
3530 RD$=SPACE$(2):CALL IBRD(DE%,RD$):GOSUB 1120
3540 CT8%=ASC(RD$)*256+(ASC(RIGHT$(RD$,1)))-1
3550 PRINT "        Acquiring a ";CT8%;" byte waveform from digitizer #8
3560 IF CHKDIM%<>0 THEN ERASE WFMS%,WFME%
3570 DIM WFMS%(511),WFME%(511):CHKDIM%=(-1)
3580 CALL IBRDI(DS%,WFMS%(0),CT6%):GOSUB 1120
3590 PRINT
3600 C6%=IBCNT%:PRINT C6%;" bytes from D6"  'keep track of bytes transferred
3610 REM
3620 CALL IBRDI(DE%,WFME%(0),CT8%):GOSUB 1120
3630 C8%=IBCNT%:PRINT C8%;" bytes from D8"  'keep track of bytes transferred
3640 RDS$=SPACE$(255)
3650 CALL IBRD(DS%,RDS$):GOSUB 1120
3660 RDS$=LEFT$(RDS$,IBCNT%)
3670 LGTH6%=CT6%
3680 MODE%=4
3690 REM ..... 'convert waveform via Tekt routine
3700 CALL DEBLK (WFMS%(0),WFMS%(0),CT6%,MODE%,LGTH6%):GOSUB 1120
3710 LE6%=LGTH6%-1
3720 RDE$=SPACE$(255)
3730 CALL IBRD(DE%,RDE$):GOSUB 1120
3740 RDE$=LEFT$(RDE$,IBCNT%)
3750 LGTH8%=CT8%
3760 MODE%=4
3770 REM ..... 'convert waveform via Tekt routine
3780 CALL DEBLK (WFME%(0),WFME%(0),CT8%,MODE%,LGTH8%):GOSUB 1120
3790 LE8%=LGTH8%-1
3800 WD$="int?"     ' ..... how many points were interpolated
3810 CALL IBWRT(DS%,WD$):CALL IBWRT(DE%,WD$):GOSUB 1120
3820 REM GOSUB 9000   'clear digitizers
3830 IPS$="":IPE$=""
3840 IPS$=SPACE$(8):CALL IBRD(DS%,IPS$):GOSUB 1120
3850 IPE$=SPACE$(8):CALL IBRD(DE%,IPE$):GOSUB 1120
3860 LET IPS%=VAL(MID$(IPS$,4,3))
3870 LET IPE%=VAL(MID$(IPE$,4,3))
3880 PRINT:PRINT "   Maximum number of consecutive ATC interpolated points:"
3890 IF IPS%=>10 THEN COLOR 10,7,1
```

```
3900 PRINT:PRINT "   Digitizer #6 = ";IPS%
3910 COLOR 10,1,7
3920 IF IPE%=>10 THEN COLOR 10,7,1
3930 PRINT:PRINT "   Digitizer #8 = ";IPE%
3940 IF IPS%<10 AND IPE%<10 THEN GOTO 4130
3950 COLOR 10,1,7
3960 PRINT:PRINT "   ************************************************"
3970 PRINT:PRINT "   Because of the digitizer(s) number of interpolated"
3980 PRINT:PRINT "   waveform points, the program is pausing. "
3990 PRINT:PRINT "   ************************************************"
4000 WARN$(WARN%)=" number of consecutive interpolated data points."
4010 WARN%=WARN%+1
4020 SOUND 40,5
4030 PRINT:PRINT "   Choices: (I)gnore   or   (S)tart over."
4040 CH$="":CH$=INKEY$:IF CH$="" THEN 4040
4050 IF CH$="i" THEN CH$="I"
4060 IF CH$="s" THEN CH$="S"
4070 IF CH$="S" THEN GOTO 10
4080 IF CH$="I" THEN GOTO 4120
4090 PRINT:PRINT "   (I) for Ignore   or   (S) for Start over, please."
4100 GOTO 4030
4110 COLOR 10,1,7
4120 '      ..... leave this line here .....
4130 V%=0:CALL IBGTS(DB%,V%)   'CONTROLLER TO STANDBY
4140  PRINT:PRINT:PRINT
4150 PRINT:PRINT "          Dividing waveforms by 2 for ATC correction.
4160 REM
4170 FOR N=0 TO 511:LET WFMS%(N)=WFMS%(N)/2:LET WFME%(N)=WFME%(N)/
2:NEXT N
4180 REM
4190 PRINT:PRINT "          Division by 2 complete.
4200 REM
4210 REM .....find the mean of the baseline (1st 26 values).....
4220 REM
4230 BLD6%=0:BLD8%=0
4240 FOR N=0 TO 25:LET BLD6%=BLD6%+WFMS%(N):NEXT N
4250 LET BLD6%=BLD6%/26
4260 FOR N=0 TO 25:LET BLD8%=BLD8%+WFME%(N):NEXT N
4270 LET BLD8%=BLD8%/26
4280 PRINT:PRINT
4290 PRINT "        Normalizing both waveforms to baseline = zero volts.
4300 REM
4310 FOR N=0 TO 511:LET WFMS%(N)=WFMS%(N)-BLD6%:NEXT N
4320 FOR N=0 TO 511:LET WFME%(N)=WFME%(N)-BLD8%:NEXT N
4330 PRINT
4340 PRINT "       ...the base line of both waveforms is now at 'zero`....
4350 REM
4360 REM ..... ROUTINE TO FIND THE MAX,MIN AND P/P OF BOTH WAVEFORMS....
4370 '
4380 PRINT:PRINT "       Calculating waveform parameters (max, min, p/p)
4390 REM
```

```
4400 TMAX6=0:TMAX8=0:VMAX6=0:VMAX8=0  'variable for t(max) and v(max)
4410 TMIN6=0:TMIN8=0:VMIN6=0:VMIN8=0  'variable for t(min) and v(min)
4420 REM ..... do all parameters in one for/next loop
4430 FOR N=0 TO 511
4440 IF WFMS%(N)>VMAX6 THEN LET TMAX6=N
4450 IF WFMS%(N)<VMIN6 THEN LET TMIN6=N
4460 IF WFME%(N)>VMAX8 THEN LET TMAX8=N
4470 IF WFME%(N)<VMIN8 THEN LET TMIN8=N
4480 IF WFMS%(N)>VMAX6 THEN LET VMAX6=WFMS%(N)
4490 IF WFMS%(N)<VMIN6 THEN LET VMIN6=WFMS%(N)
4500 IF WFME%(N)>VMAX8 THEN LET VMAX8=WFME%(N)
4510 IF WFME%(N)<VMIN8 THEN LET VMIN8=WFME%(N)
4520 NEXT N
4530 LET RMX6=VMAX6:LET RMX8 = VMAX8
4540 LET RMN6=VMIN6:LET RMN8 = VMIN8
4550 '
4560 LET VMAX6=(VMAX6/64)*VS1:LET VMAX8=(VMAX8/64)*VS2
4570 LET VMIN6=(VMIN6/64)*VS1:LET VMIN8=(VMIN8/64)*VS2
4580 LET TMAX6=(TMAX6/51.2)*HS1:LET TMAX8=(TMAX8/51.2)*HS2
4590 REM
4600 REM ..... present waveform parameters .....
4610 CLS
4620 BLAV6=0:BLAV8=0  ' check the baselines
4630 FOR N = 0 TO 25:LET BLAV6=BLAV6+ABS(WFMS%(N)):NEXT N
4640 FOR N = 0 TO 25:LET BLAV8=BLAV8+ABS(WFME%(N)):NEXT N
4650 BLAV6 = BLAV6/26:BLAV8 = BLAV8/26
4660 '
4670 '
4680 IF BLAV6< 0 THEN BLAV6= BLAV6* (-1)
4690 IF BLAV6< (.01*RMX6) THEN BLAV6=0
4700 IF BLAV8< 0 THEN BLAV8= BLAV8* (-1)
4710 IF BLAV8< (.01*RMX8) THEN BLAV8=0
4720 IF  BLAV6 = 0 THEN GOTO 4840
4730 IF BLAV6<>0 THEN COLOR 10,7,1
4740 IF BLAV6<>0 THEN PRINT "  ....."
4750 IF BLAV6<>0 THEN PRINT "        >>>>>>  WARNING  <<<<<< "
4760 IF BLAV6<>0 THEN  PRINT:PRINT "      CHECK BASELINE FOR DIGITIZER #6  "
4770 IF BLAV6<>0 THEN PRINT "  ....."
4780 IF BLAV6<>0 THEN PRINT
4790 IF BLAV6<>0 THEN LET WARN$(WARN%)=" base-line for digitizer #6."
4800 IF BLAV6<>0 THEN LET WARN%=WARN%+1
4810 IF BLAV6<>0 THEN SOUND 40,5
4820 COLOR 10,1,7
4830 '
4840 IF  BLAV8 = 0 THEN GOTO 4950
4850 IF BLAV8<>0 THEN COLOR 10,7,1
4860 IF BLAV8<>0 THEN PRINT "  ....."
4870 IF BLAV8<>0 THEN PRINT "        >>>>>>  WARNING  <<<<<< "
4880 IF BLAV8<>0 THEN  PRINT:PRINT "      CHECK BASELINE FOR DIGITIZER #8  "
4890 IF BLAV8<>0 THEN PRINT "  ....."
4900 IF BLAV8<>0 THEN LET WARN$(WARN%)=" base-line for digitizer #8."
```

```
4910 IF BLAV8<>0 THEN LET WARN%=WARN%+1
4920 IF BLAV8<>0 THEN SOUND 40,5
4930 COLOR 10,1,7
4940 '
4950 IF BLAV6 = 0 AND BLAV8 = 0 THEN GOTO 5040
4960 PRINT:PRINT "    Choices:  (I)gnore    or   (S)tart over."
4970 CH$="":CH$=INKEY$:IF CH$="" THEN 4970
4980 IF CH$="i" THEN CH$="I"
4990 IF CH$="s" THEN CH$="S"
5000 IF CH$="S" THEN GOTO 10
5010 IF CH$="I" THEN GOTO 5040
5020 PRINT:PRINT "    (I) for Ignore   or   (S) for Start over, please."
5030 GOTO 4960
5040 PRINT:PRINT "    Max of d6 = ";VMAX6;" V.  Max of d8 = ";VMAX8;" V."
5050 PRINT
5060 PRINT "    Min of d6 = ";VMIN6;" V.  Min of d8 = ";VMIN8;" V."
5070 PRINT:PRINT "    Time of Maximum for d6 = ";TMAX6/1E-09;" ns
5080 PRINT "    Time of Maximum for d8 = ";TMAX8/1E-09;" ns
5090 REM
5100 REM
5110 REM ..... input annotation, transfer functions, etc .....
5120 REM
5130 PRINT:PRINT "    Input any comment you wish to accompany this data...
5140 REM
5150 CM6$=SPACE$(255):CM8$=SPACE$(255)
5160 PRINT "    .....use 'space-bar ` / return  for none.....
5170 PRINT:PRINT "    Input 'XXX'  [ three letters (x) ] to start over again"
5180 INPUT CM$
5190 IF CM$ = "XXX" OR CM$ = "xxx" THEN GOTO 10
5200 GOSUB 9180    '  caps for anno
5210 CM6$=CM$:CM8$=CM$
5220 PRINT
5230 GOSUB 9550  ' get probe inputs if required
5240 '
5250 CLS
5260 PRINT:PRINT "      INPUT THE NAME OF THE DEVICE UNDER TEST (DUT)
5270 INPUT DUT$
5280 GOSUB 9020
5290 DUT6$=DUT$:DUT8$=DUT$
5300 CLS:PRINT:PRINT       ' ..... another page
5310 REM
5320 REM ..... present the results for approval .....
5330 REM
5340 PRINT "Comments are : ";CM6$
5350 PRINT:PRINT
5360 PRINT "Device under test is : ";DUT$
5370 PRINT:PRINT
5380 PRINT "Probe type for digitizer #6 is : ";PT6$
5390 PRINT
5400 TF6$="TF6 = * "+STR$(TF6)
5410 PRINT TF6$
```

```
5420 PRINT
5430 PRINT "Probe type for digitizer #8 is : ";PT8$
5440 PRINT
5450 TF8$="TF8 = * "+STR$(TF8)
5460 PRINT TF8$
5470 PRINT
5480 PRINT:PRINT
5490 REM ..... offer choice to re-do inputs .....
5500 PRINT "     IF ABOVE IS O.K. INPUT A 'Y' TO GRAPH DATA
5510 PRINT
5520 PRINT "     IF NOT, INPUT AN 'N' TO INPUT INFORMATION AGAIN
5530 CH$="":CH$=INKEY$:IF CH$="" THEN 5530
5540 IF CH$="y" OR CH$="Y" THEN 5620
5550 IF CH$="n" OR CH$="N" THEN CLS
5560 IF CH$="n" OR CH$="N" THEN 5130
5570 PRINT " ..... 'y' or 'n' please .....
5580 GOTO 5500
5590 REM
5600 IF INKEY$="" THEN 5600
5610 REM
5620 REM .....graph waveform data .....
5630 REM
5640 REM
5650 REM
5660 REM
5670 BC%=(CT6%/2)-1
5680 VZ=BLD6%
5690 HI=HS1
5700 SCREEN 2,0:VIEW:CLS          'set up & clear hi res graphics screen
5710 REM
5720 DEF SEG                      'restore SEG for IBM Color/Graphics
5730 REM
5740 VIEW:CLS:ON ERROR GOTO 0     'clear screen
5750 REM
5760 YL=YI*8          '128          224
5770 '          CALCULATE THE WINDOWS
5780 LET MAX6 = INT(RMX6/64):LET MAX6=MAX6+1:LET MAX6=MAX6*64
5790 LET MAX8 = INT(RMX8/64):LET MAX8=MAX8+1:LET MAX8=MAX8*64
5800 LET MIN6 = INT(RMN6/64):LET MIN6=MIN6*64
5810 LET MIN8 = INT(RMN8/64):LET MIN8=MIN8*64
5820 IF MIN6 = 0 THEN LET MIN6 = (-64)
5830 IF MIN8 = 0 THEN LET MIN8 = (-64)
5840 '
5850 '     window for d6 is max6/min6
5860 '     window for d8 is max8/min8
5870 REM ..... set up window for waveform for d6 .....
5880 REM
5890 VIEW (120,0)-(400,75)
5900 WINDOW (0,MIN6)-(BC%,MAX6)
5910 REM  ..... draw border .....
5920 LINE (0, MIN6)-(BC%, MAX6),,B
```

```
5930 REM ..... draw horizontal lines .....
5940 FOR LN=MIN6 TO MAX6 STEP 64
5950 LINE (0,LN)-(BC%,LN),,,&HCCCC
5960 NEXT LN
5970 REM
5980 REM ..... draw vertical lines .....
5990 REM
6000 FOR LN=0 TO BC%  STEP BC%/10
6010 LINE (LN,MIN6)-(LN,MAX6),,,&HCCCC
6020 NEXT LN
6030 REM
6040 LOCATE 5,2
6050 REM
6060 REM ..... draw the waveform for d6 .....
6070 REM
6080 LINE (BS%,WFMS%(BS%))-(BS%,WFMS%(BS%))
6090 FOR I%=BS%+1 TO BC%
6100 LINE -(I%,WFMS%(I%))
6110 NEXT I%
6120 REM ..... set up window for waveform for d8 .....
6130 VIEW (120, 97)-(400,170)
6140 WINDOW (0,MIN8)-(BC%,MAX8)
6150 REM ..... draw border .....
6160 LINE (0, MIN8)-(BC%, MAX8),,B
6170 REM ..... draw horizontal lines .....
6180 FOR LN=MIN8 TO MAX8 STEP 64
6190 LINE (0,LN)-(BC%,LN),,,&HCCCC
6200 NEXT LN
6210 REM
6220 REM ..... draw vertical lines .....
6230 REM
6240 FOR LN=0 TO BC%  STEP BC%/10
6250 LINE (LN,MIN8)-(LN,MAX8),,,&HCCCC
6260 NEXT LN
6270 REM
6280 LOCATE 5,2
6290 REM
6300 REM
6310 REM ..... draw the waveform for d8 .....
6320 REM
6330 LINE (BS%,WFME%(BS%))-(BS%,WFME%(BS%))
6340 FOR I%=BS%+1 TO BC%
6350 LINE -(I%,WFME%(I%))
6360 NEXT I%
6370 REM ..... locate positions and print screen annotation .....
6380 REM
6390 LOCATE 5,2:PRINT "DIG #6
6400 LOCATE 18,2:PRINT "DIG #8
6410 LOCATE 1,10:PRINT (MAX6/64)*VS1;" V."
6420 'LOCATE 5,11:PRINT "OV
6430 LOCATE 10,10:PRINT (MIN6/64)*VS1;" V."
```

```
6440 LOCATE 13,10:PRINT (MAX8/64)*VS2;" V."
6450 'LOCATE 17,11:PRINT "0V
6460 LOCATE 22,10:PRINT (MIN8/64)*VS2;" V."
6470 LOCATE 2,52:PRINT "DATA NAME : ";N6$
6480 LOCATE 4,52:PRINT "D.U.T. is ";DUT6$
6490 LOCATE 5,52:PRINT "Probe is ";PT6$
6500 LOCATE 6,52:PRINT "DISK #";DN6%;" TF=( * ";TF6;")"
6510 LOCATE 7,52:PRINT "MAX= ";VMAX6;" V"
6520 LOCATE 8,52:PRINT "T of MAX=";INT(TMAX6/1E-09);" NS"
6530 LOCATE 9,52:PRINT "MIN= ";VMIN6;" V"
6540 REM LOCATE 10,55:PRINT TF6$
6550 LOCATE 14,52:PRINT "DATA NAME : ";N8$
6560 LOCATE 16,52:PRINT "D.U.T. is ";DUT8$
6570 LOCATE 17,52:PRINT "Probe is ";PT8$
6580 LOCATE 18,52:PRINT "DISK #";DN8%;" TF=( * ";TF8;")"
6590 LOCATE 19,52:PRINT "MAX= ";VMAX8;" V"
6600 LOCATE 20,52:PRINT "T of MAX=";INT(TMAX8/1E-09);" NS"
6610 LOCATE 21,52:PRINT "MIN= ";VMIN8;" V"
6620 REM LOCATE 22,55:PRINT TF8$
6630 '
6640 LOCATE 11,26:PRINT HS1/1E-09;" NS/DIV"
6650 LOCATE 12,26:PRINT HS2/1E-09;" NS/DIV"
6660 LOCATE 23,16:PRINT CM$
6670 REM
6680 REM .....end of graph routine .....
6690 REM
6700 IF INKEY$="" THEN 6700
6710 CLS:SCREEN 0,2 :COLOR 10,1,7:ON ERROR GOTO 0:CLS
6720 PRINT:PRINT
6730 PRINT "     OPTIONS : "
6740 PRINT "          (1) Save the data
6750 PRINT "          (2) Reject data (start over)
6760 PRINT "          (3) Return to the Menu
6770 CH$="":CH$=INKEY$:IF CH$="" THEN 6770
6780 IF CH$="1" THEN GOTO 6860
6790 IF CH$="2" THEN GOTO 10
6800 IF CH$="3" THEN CHAIN "menu79.ddt"
6810 PRINT:PRINT "  valid input are :  1  or  2  or  3  , please."
6820 GOTO 6720
6830 CLS
6840 PRINT "          DATA NOW BEING FILED
6850 REM
6860 REM ..... file the data .....
6870  PRINT:PRINT:HLD%=0
6880 FOR N = 1 TO 10
6890 IF WARN$(N)<>"" THEN PRINT "WARNING # ";N;". ";WARN$(N)
6900 IF WARN$(N)<>"" THEN HLD%=1
6910 NEXT N
6920 IF HLD%=0 THEN GOTO 7040
6930 PRINT:PRINT
6940 PRINT " ^^ above are any note(s) of warning for this data cycle ^^ "
```

```
6950 PRINT "  ____________________________________________________"
6960 PRINT:PRINT "    Choices:  (I)gnore    or   (S)tart over."
6970 CH$="":CH$=INKEY$:IF CH$="" THEN 6970
6980 IF CH$="i" THEN CH$="I"
6990 IF CH$="s" THEN CH$="S"
7000 IF CH$="S" THEN GOTO 10
7010 IF CH$="I" THEN GOTO 7040
7020 PRINT:PRINT "    (I) for Ignore  or  (S) for Start over, please."
7030 GOTO 6960
7040 PRINT:PRINT "  Please wait ....filing the data."
7050 ON ERROR GOTO 0
7060 REM
7070 CLOSE #1:CLOSE #2
7080 VU$="V":HU$="S"
7090 FL$="A:"+N6$
7100 OPEN FL$ FOR OUTPUT AS #1
7110                                                              WRITE
#1,LE6%,N6$,VS1,HS1,VMAX6,TMAX6,VMIN6,TI$,DA$,CM6$,TF6,TF6$,DN6%
7120 WRITE #1,DUT6$,PT6$
7130 CT%=0
7140 WRITE #1,WFMS%(CT%)
7150 CT%=CT%+1
7160 IF CT%<=LE6% THEN 7140
7170 CLOSE #1
7180 FL$="A:"+N8$
7190 OPEN FL$ FOR OUTPUT AS #2
7200                                                              WRITE
#2,LE8%,N8$,VS2,HS2,VMAX8,TMAX8,VMIN8,TI$,DA$,CM8$,TF8,TF8$,DN8%
7210 WRITE #2,DUT8$,PT8$
7220 CT%=0
7230 WRITE #2,WFME%(CT%)
7240 CT%=CT%+1
7250 IF CT%<=LE8% THEN 7230
7260 CLOSE #2
7270 REM ..... update the shot-file .....
7280 OPEN "SHOT79.FIL" FOR APPEND AS #1
7290 REM
7300                                                              WRITE
#1,LE6%,N6$,VS1,HS1,VMAX6,TMAX6,VMIN6,TI$,DA$,CM6$,TF6,TF6$,DN6%
7310 WRITE #1,DUT6$,PT6$
7320                                                              WRITE
#1,LE8%,N8$,VS2,HS2,VMAX8,TMAX8,VMIN8,TI$,DA$,CM8$,TF8,TF8$,DN8%
7330 WRITE #1,DUT8$,PT8$
7340 CLOSE #1
7350 REM ..... store shot numbers so not used again today .....
7360 REM
7370 OPEN "daily.chk" FOR APPEND AS #1
7380 WRITE #1,N6$,N8$
7390 CLOSE #1
7400 REM ..... end of data filing routine .....
7410 REM
```

```
7420 SCREEN 0,2:KEY OFF:COLOR 10,1,7:GOTO 50
7430 REM ..... check to see data diskette is numbered .....
7440 REM
7450 CLOSE #1
7460 ON ERROR GOTO 7520   '..... trap open door, etc
7470 OPEN "A:DISKNUM.DDT" FOR INPUT AS #1
7480 IF EOF(1) THEN 7500
7490 INPUT #1,FL$,CM$,DA$,TI$,DN%
7500 CLOSE #1
7510 RETURN
7520 BEEP:IF ERR=71 THEN 7570
7530 IF ERR=53 THEN 7650
7540 IF ERR<>53 OR ERR<>71 THEN PRINT ERR
7550 IF ERR<>53 OR ERR<>71 THEN PRINT " .... stopping because of error # ";ERR
7560 IF ERR<>53 OR ERR<>71 THEN STOP
7570 IF ERR=71 THEN PRINT "       Drive 'A` is not ready for data."
7580 IF ERR=71 THEN PRINT:PRINT "   Hit any key EXCEPT (M) when drive A is ready,"
7590 IF ERR=71 THEN PRINT:PRINT "   or, use (M) to return to main Menu."
7600 CH$="": CH$=INKEY$:IF ERR=71 AND CH$="" THEN 7600
7610 IF CH$="m" OR CH$="M" THEN CHAIN "MENU79.DDT"
7620 IF CH$="m" OR CH$="M" THEN END
7630 IF ERR=71 THEN RESUME 50
7640 REM ..... if no disk # found, warn and return to main menu .....
7650 IF ERR =53 THEN PRINT "       The program can not find a reference number"
7660 IF ERR =53 THEN PRINT "     on the disk in drive A. Hit any key to return"
7670 IF ERR=53 THEN PRINT "   return to the Main Menu; see 'Number Disk 'option."
7680 IF ERR=53 AND INKEY$="" THEN 7680
7690 CHAIN "MENU79.DDT"
7700 STOP
7710 REM .....sub-routine to check if file name has been used today
7720 DA$=""
7730 ON ERROR GOTO 7770
7740 CLOSE #1:OPEN "DAILY.CHK" FOR INPUT AS #1
7750 INPUT #1,DT$
7760 CLOSE #1
7770 CLOSE #1:IF ERR=53 THEN GOTO 7830
7780 IF DT$=DATE$ THEN 7910   'if todays file, check names used
7790 REM
7800 REM .....if not todays file, then make one for today.....
7810 REM
7820 IF DT$<>DATE$ THEN KILL "DAILY.CHK"
7830 IF DT$<>DATE$  THEN OPEN "DAILY.CHK" FOR OUTPUT AS #1
7840 IF DT$<>DATE$  THEN WRITE #1,DATE$
7850 IF DT$<>DATE$ THEN CLOSE #1
7860 IF ERR=53 THEN RESUME 7870
7870 IF DT$<>DATE$ THEN RETURN
7880 PRINT "STOPPING BECAUSE OF ERROR IN THE FILE CHECK ROUTINE"
7890 STOP
7900 REM
7910 REM ..... check what file names are in the daily file .....
7920 REM
```

```
7930 CLOSE #1
7940 OPEN "DAILY.CHK" FOR INPUT AS #1
7950 INPUT #1,DT$
7960 FOR N=1 TO 999
7970 IF EOF(1) THEN 8030
7980 INPUT #1,CKFL$
7990 IF CKFL$=N6$ THEN 8050
8000 IF CKFL$=N8$ THEN 8050
8010 NEXT N
8020 CLOSE #1
8030 IF VAL(EXT$)<>(VAL(LPN$)+1) THEN GOTO 8330
8040 RETURN
8050 CLOSE #1:CLS     '.....check pulse number
8060 ON ERROR GOTO 0
8070 OPEN "DAILY.CHK" FOR INPUT AS #1
8080 INPUT #1,DT$
8090 FOR N=1 TO 999
8100 IF EOF(1) THEN 8170
8110 INPUT #1,CKFL$
8120 PRINT
8130 IF CKFL$=N6$ THEN PRINT MID$(N6$,10,3);"  HAS BEEN USED AS A SHOT
NUMBER
8140 IF CKFL$=N6$ THEN SOUND 40,5
8150 NEXT N
8160 CLOSE #1
8170 '
8180 PRINT:PRINT "The last pulse number found for today was : ";LPN$
8190 PRINT:PRINT "INPUT A NEW SHOT NUMBER PLEASE  (rem: three digits)
8200 INPUT EXT$       '..... input another ext and re-check it .....
8210 IF LEN(EXT$)<>3 THEN PRINT "  ";EXT$;"  LENGTH NOT RIGHT
8220 IF LEN(EXT$)<>3 THEN GOTO 8190
8230 GB%=0
8240 FOR N = 1 TO 3
8250  CE%=ASC(MID$(EXT$,N,1))
8260 IF CE%<48 OR CE%>57 THEN PRINT " Can't use [ ";MID$(EXT$,N,1);" ], numbers only
please."
8270 IF CE%<48 OR CE%>57 THEN GB%=1
8280 NEXT N
8290 IF GB%<>0 THEN SOUND 40,5
8300 IF GB%<>0 THEN GOTO 8190
8310 '                ..... is number consecutive
8320 IF VAL(EXT$)=(VAL(LPN$)+1) THEN GOTO 8460
8330 CLS:SOUND 40,3:PRINT "      >>>>>>>>>>> WARNING <<<<<<<<<<<<<  "
8340 PRINT :PRINT "        Pulse number [ ";EXT$;" ] is not consecutive. "
8350 PRINT :PRINT "        The last pulse number found was : ";LPN$
8360 PRINT :PRINT "  Choices :  (C)hange pulse number or (I)gnore warning."
8370 CH$="":CH$=INKEY$:IF CH$="" THEN 8370
8380 IF CH$="c" THEN CH$="C"
8390 IF CH$="i" THEN CH$="I"
8400 IF CH$="I" THEN WARN$(WARN%)=WARN$+" this data has a non-consecutive pulse
number"
```

```
8410 IF CH$="I" THEN WARN%=WARN%+1
8420 IF CH$="C" THEN 8190
8430 IF CH$="I" THEN 8460
8440 PRINT "          ( I ) for ignore or (C) for change, please.
8450 GOTO 8330
8460 LET N6$=MID$(N6$,1,9)+EXT$
8470 LET N8$=MID$(N8$,1,9)+EXT$
8480 RETURN
8490 REM ..... sub-routine to check intensities and time base equality
8500 REM
8510 GOSUB 3140   'clear digitizers
8520 WD$="":WD$=SPACE$(5):WD$="MAI?;"  'what intensity  ? (message)
8530 CALL IBWRT (DS%,WD$):CALL IBWRT(DE%,WD$):GOSUB 1100  'ask ? : err chk
8540 RIS$="":RIE$="": RIS$=SPACE$(8):RIE$=SPACE$(8)
8550 CALL IBRD(DS%,RIS$):CALL IBRD(DE%,RIE$):GOSUB 1100  'read int:err chk
8560 REM
8570 GOSUB 3140      'clear digitizers
8580 MI6=VAL(MID$(RIS$,5,7))      'number value for d6 intensity
8590 MI8=VAL(MID$(RIE$,5,7))      'number value for d8 intensity
8600 REM
8610 CALL IBWRT(DS%,WD$):CALL IBWRT(DE%,WD$):GOSUB 1100  'set horz PI : err chk
8620 WD$=""
8630 REM
8640 REM ..... inform if intensity(s) not high enough .....
8650 REM
8660 IF MI6<200 THEN CLS
8670 IF MI6<200 THEN BEEP:IF MI6<200 THEN PRINT "      **********"
8680 IF MI6<200 THEN PRINT "     intensity for digitizer #6 is set for : ";MI6
8690 IF MI6<200 THEN PRINT "    intensity for digitizer #6 is probably too low.
8700 IF MI6>350 THEN PRINT "    intensity for digitizer #6 is probably TOO HIGH
8710 REM
8720 REM
8730 REM
8740 IF MI8<200 THEN CLS
8750 IF MI8<200 THEN BEEP:IF MI8<200 THEN PRINT "      **********
8760 IF MI8<200 THEN PRINT "      intensity for digitizer #8 is set for : ";MI
8770 IF MI8<200 THEN PRINT "   intensity for digitizer #8 is probably too low.
8780 IF MI8>350 THEN PRINT "   intensity for digitizer #8 is probably TOO HIGH
8790 IF MI8<200 OR MI6<200 THEN GOSUB 9350
8800 IF MI8>350 OR MI6>350 THEN GOSUB 9350
8810 GOSUB 3140:GOSUB 1100  'clear digitizers : error check
8820 WD$=SPACE$(5):WD$="hs1?;"
8830 CALL IBWRT(DS%,WD$):CALL IBWRT(DE%,WD$):GOSUB 1100  'find time
8840 RD6$=SPACE$(12):RD8$=SPACE$(12)
8850 REM
8860 CALL IBRD (DS%,RD6$):CALL IBRD(DE%,RD8$)  'find chosen time
8870 WD$="":GOSUB 3140    'clear digitizers
8880 CK%=0:IF RD6$<>RD8$ THEN CK%=-1
8890 IF CK%=0 THEN RETURN
8900 REM
8910 REM ..... warning for non-equality in time/div. .....
```

```
8920 REM
8930 IF CK% THEN COLOR 1,15:IF CK% THEN SOUND 40,5
8940 IF CK% THEN PRINT "TIME BASES NOT THE SAME ON BOTH DIGITIZERS"
8950 IF CK% THEN PRINT ">> HIT ANY KEY TO CONTINUE <<
8960 IF CK% THEN LET ET$= " TIME BASE SETTINGS NOT EQUAL "
8970 IF INKEY$="" THEN 8970
8980 RETURN
8990 STOP
9000 FOR N=1 TO 1000:N=N:NEXT N:RETURN     'just a read message delay
9010 REM
9020 REM ..... routine to capatilize all letters in the DUT
9030 ST$=DUT$
9040 LET LST=LEN(ST$)
9050 FOR N=1 TO LST
9060 LET L$=MID$(ST$,N,1)
9070 IF ASC(L$)=>97 THEN IF ASC(L$)<=122 THEN GOSUB 9120
9080 NEXT N
9090 DUT$=ST$
9100 RETURN
9110 STOP
9120 LET FRONT$=MID$(ST$,1,N-1)
9130 LET REAR$=MID$(ST$,N+1,LST)
9140 LET NV=ASC(L$)-32
9150 LET L$=CHR$(NV)
9160 LET ST$=FRONT$+L$+REAR$
9170 RETURN
9180 REM ..... routine to capatilize all letters in the ANNOTATION
9190 LET ST$=CM$
9200 LET LST=LEN(ST$)
9210 FOR N=1 TO LST
9220 LET L$=MID$(ST$,N,1)
9230 IF ASC(L$)=>97 THEN IF ASC(L$)<=122 THEN GOSUB 9280
9240 NEXT N
9250 CM$=ST$
9260 RETURN
9270 STOP
9280 LET FRONT$=MID$(ST$,1,N-1)
9290 LET REAR$=MID$(ST$,N+1,LST)
9300 LET NV=ASC(L$)-32
9310 LET L$=CHR$(NV)
9320 LET ST$=FRONT$+L$+REAR$
9330 RETURN
9340 REM
9350 REM .... urge re-take of data
9360 COLOR 12,0,7:PRINT
9370 REM
9380 PRINT:PRINT "      DUE TO THE INTENSITY SETTING, OF ONE OR BOTH"
9390 PRINT "      OF THE DIGITIZERS, THIS DATA WILL PROBABLY BE INVALID."
9400 BEEP
9410 PRINT "      INPUT `Y` TO REPEAT DATA COLLECTION  or"
9420 PRINT
```

```
9430 PRINT "      INPUT 'N' TO CONTINUE"
9440 ET$="   INTENSITY SET TOO LOW."
9450 CH$="":CH$=INKEY$:IF CH$="" THEN 9450
9460 COLOR 10,1,7
9470 IF CH$="N" OR CH$="n" THEN LET WARN$(WARN%)= " intensity setting(s) "
9480 IF CH$="N" OR CH$="n" THEN LET WARN%= WARN% +1
9490 IF CH$="N" OR CH$="n" THEN RETURN
9500 IF CH$="Y" OR CH$="y" THEN GOTO 2320
9510 PRINT:PRINT "      'Y' or 'N'  please
9520 GOTO 9380
9530 '
9540 '
9550 REM  .....(probe79.sub) .....7912 change probe type routine .....
9560 CLOSE #1:OPEN "PROBE79.DDT" FOR INPUT AS #1
9570 INPUT #1,PT6$,TF6,PT8$,TF8
9580 CLOSE #1
9590 '
9600 CLS:PRINT:PRINT
9610 PRINT "      Currently listed 7912 probes in use : "
9620 PRINT
9630 PRINT "   The probe listed for digitizer #6  is : ";PT6$
9640 PRINT
9650 PRINT "   The transfer function listed for above probe is : ";TF6
9660 PRINT
9670 PRINT "   The probe listed for digitizer #8  is : ";PT8$
9680 PRINT
9690 PRINT "   The transfer function for above probe is : ";TF8
9700 PRINT:PRINT
9710 PRINT "      If the above is O.K. input 'y ' "
9720 PRINT
9730 PRINT "   If not, then input 'n' to change probes or transfer functions."
9740 '
9750 CH$="": CH$=INKEY$: IF CH$="" THEN 9750
9760 IF CH$="y" THEN CH$="Y"
9770 IF CH$="n" THEN CH$="N"
9780 IF CH$="Y" THEN RETURN
9790 IF CH$ = "N" THEN 9820
9800 PRINT:PRINT "      'y' or 'n'  please "
9810 GOTO 9710
9820 CLS:PRINT:PRINT
9830 P6$=PT6$:P8$=PT8$:PT6$="":PT8$=""
9840 PRINT "    Routine to change the probe types for 7912 DDT testing. "
9850 PRINT:PRINT
9860 PRINT "   The probe for digitizer #6 was : ";P6$
9870 PRINT
9880 PRINT "   The transfer function for above probe was : ";TF6
9890 PRINT
9900 PRINT "  Input the new probe type  "
9910 INPUT PT6$
9920 GOSUB 10280      ' capitol letters routine
```

```
9930 PRINT
9940 PRINT " Input the new transfer function for this probe ."
9950 INPUT TF6
9960 CLS:PRINT:PRINT
9970 PRINT "    The probe for digitizer #8 was : ";P8$
9980 PRINT
9990 PRINT "    The transfer function for above probe is : ";TF8
10000 PRINT
10010 PRINT " Input the new probe type  "
10020 INPUT PT8$
10030 GOSUB 10280      ' capitol letters routine
10040 PRINT
10050 PRINT " Input the new transfer function for this probe ."
10060 INPUT TF8
10070 CLS
10080 PRINT :PRINT
10090 PRINT " Probe / transfer function for digitizer #6 is: ";PT6$;" / ";TF6
10100 PRINT:PRINT
10110 PRINT " Probe / transfer function for digitizer #8 is: ";PT8$;" / ";TF8
10120 PRINT:PRINT
10130 PRINT "      If the above is OK then input a `Y` for yes.
10140 PRINT
10150 PRINT "      To correct inputs, input `N`.
10160 CS$="":CS$=INKEY$:IF CS$="" THEN 10160
10170 IF CS$="n" OR CS$= "N" THEN 9550
10180 IF CS$="y" OR CS$= "Y" THEN  10210
10190 PRINT:PRINT " `Y` OR `N` PLEASE
10200 GOTO 10120
10210 CLOSE #1
10220 KILL "PROBE79.DDT"
10230 OPEN "PROBE79.DDT" FOR OUTPUT AS #1
10240 WRITE #1,PT6$,TF6,PT8$,TF8
10250 CLOSE #1
10260 RETURN
10270 STOP
10280 REM ..... to make all capital letters in the probe type .....
10290 IF PT6$<>"" AND PT8$="" THEN LET ST$=PT6$
10300 IF PT6$<>"" AND PT8$<>"" THEN LET ST$=PT8$
10310 LET LST=LEN(ST$)
10320 FOR N=1 TO LST
10330 LET L$=MID$(ST$,N,1)
10340 IF ASC(L$)=>97 THEN IF ASC(L$)<=122 THEN GOSUB 10400
10350 NEXT N
10360 IF PT6$<>"" AND PT8$="" THEN LET PT6$=ST$
10370 IF PT6$<>"" AND PT8$<>"" THEN LET PT8$=ST$
10380 RETURN
10390 STOP
10400 LET FRONT$=MID$(ST$,1,N-1)
10410 LET REAR$=MID$(ST$,N+1,LST)
10420 LET NV=ASC(L$)-32
```

```
10430 LET L$=CHR$(NV)
10440 LET ST$=FRONT$+L$+REAR$
10450 RETURN
10460 '         last line of start.ddt  24-feb-89.....jjl
```

Appendix F.—Graph Data Program

```
10 REM  Appendix F..(GRAPH79.BW).... MAR 89.....JJL
20 SCREEN 0,0:SCREEN 2,0:KEY OFF:CHDIR "C:\GURU"
30 CLS:SCREEN 0,2:COLOR 15,7,8
40 CLS: CLEAR :DIM A$(250),F$(250), WFM%(5),DR$(80)
50 '
60 PRINT:PRINT "     GRAPH ROUTINE FOR 7912 DATA
70 PRINT:PRINT "     PURPOSE :  To retrieve disk stored 7912 data and present
80 PRINT:PRINT "               it on the monitor.
90 PRINT:PRINT "  OPTIONS :  Input the drive letter (a,b, or c) where";
100 PRINT " the data is stored ."
110 PRINT:PRINT "          Input ( M ) to return to menu."
120 '
130 CH$="":CH$=INKEY$:IF CH$="" THEN 130
140 IF CH$="m" OR CH$="M" THEN CHAIN "menu79.ddt"
150 IF CH$="a" THEN CH$="A"
160 IF CH$="b" THEN CH$="B"
170 IF CH$="c" THEN CH$="C"
180 IF CH$="A" OR CH$="B" OR CH$="C" THEN GOTO 240
190 PRINT:PRINT "  INPUT MUST BE  ( A , B , C , or M ) PLEASE."
200 PRINT:PRINT
210 SOUND 50,5
220 GOTO 90
230 '
240 ' ..... purpose: find all 7912 files on a disk and make a directory
250 ' ..... 7912 files begin with 'D6' or D8, but are filed as sets
260 '
270 CLS:PRINT:PRINT
280 PRINT "        SEARCHING DRIVE : ( ";CH$;" ) FOR 7912 DATA "
290 '
300 '
310 KB$=CH$
320 '
330 CHDIR KB$+":\"
340  IF CH$="C" THEN CHDIR "C:\GURU"
350 LET DR$="dir "+KB$+": lsort>c:sort79.dir"   'files sorted
360 SHELL DR$
370 CLOSE #1
380 CNF=1
390 '
400 OPEN "c:sort79.dir" FOR INPUT AS #1    ' numbered files presented
410 FOR N=1 TO 250
420 IF EOF(1)= -1 THEN 470
```

```
430 INPUT #1,B$
440 IF MID$(B$,1,2)="D6" THEN LET F$(CNF)=MID$(B$,3,6)+"."+MID$(B$,10,3)
450 IF MID$(B$,1,2)="D6" THEN LET CNF=CNF+1
460 NEXT N
470 CLOSE #1
480 '
490 PRINT:PRINT
500 IF CNF<>1 THEN GOTO 560
510  PRINT "     COULD NOT FIND ANY DATA WHERE THE FILE NAMES "
520  PRINT "     BEGIN  WITH ' D6 ' FOR 'DIGITIZER 6'."
530  PRINT "     HIT ANY KEY TO CONTINUE "
540  IF INKEY$="" THEN 540
550 GOTO 20
560 '          ..... keep this line
580 '
590  CLS:SCREEN 2,0:VIEW:CLS:KEY OFF
600 ON ERROR GOTO 0
610 '          .....
620 '
630 CLS          ' keep this line
640 '
650 GOSUB 2910          'present the files
660 '
670 LOCATE 23,1:PRINT "       A directory of 7912 data files on disk A is above."
680 '
690 LOCATE 24,1
700 PRINT "INPUT ONE FILE NUMBER OF THE SET TO BE GRAPHED or 'ZERO` to
RETURN";
710 PRINT " to MAIN MENU
720 '
730 INPUT FLN
740 IF FLN=0  THEN CHAIN "menu79.DDT"
750 '
760 CLS:GOSUB 2480       '     read data from disk
770 '
780 '
790 REM .....graph waveform data .....
800 '
810 FR% = 0 :  BK% = BC%   ' initial time window for all data
820 '
830 OPER$=""          ' string to detect operation to perform on data
840 '
```

```
850 SCREEN 2,0:VIEW:CLS              'set up & clear hi res graphics screen
860 DEF SEG                    'restore SEG for IBM Color/Graphics
870 VIEW:CLS:ON ERROR GOTO 0         'clear screen
880 '
890 '
900 '            CALCULATE THE WINDOWS
910 '
920 LET MAX6 = INT(RMX6/64):LET MAX6=MAX6+1:LET MAX6=MAX6*64
930 LET MAX8 = INT(RMX8/64):LET MAX8=MAX8+1:LET MAX8=MAX8*64
940 LET MIN6 = INT(RMN6/64):LET MIN6=MIN6*64:IF MIN6=0 THEN LET MIN6 = (-1)
950 LET MIN8 = INT(RMN8/64):LET MIN8=MIN8*64:IF MIN8 = 0 THEN LET MIN8 = (-1)
960 '
970 '      window for d6 is max6/min6
980 '      window for d8 is max8/min8
990 '
1000 ' ..... set up window for waveform for d6
1020 WINDOW (FR%,MIN6)-(BK%,MAX6)
1030 '  ..... draw border
1040 LINE (0, MIN6)-(BK%, MAX6),,B
1050 '  ..... draw horizontal lines
1060 FOR LN=MIN6 TO MAX6 STEP 64
1070 LINE (0,LN)-(BK%,LN),,,&HCCCC
1080 NEXT LN
1090 ' ..... draw vertical lines
1100 '
1110 FOR LN=0 TO BC%  STEP BC%/10
1120 LINE (LN,MIN6)-(LN,MAX6),,,&HCCCC
1130 NEXT LN
1140 LOCATE 5,2
1150 '
1160 '  ..... draw the waveform for d6
1180 LINE (BS%,WFMS%(BS%))-(BS%,WFMS%(BS%))
1190 FOR I%=BS%+1 TO BC%
1200 LINE -(I%,WFMS%(I%))
1210 NEXT I%
1220 '  ..... set up window for waveform for d8
1230 VIEW (120, 97)-(400,170)
1240 WINDOW (FR%,MIN8)-(BK%,MAX8)
1250 '  ..... draw border
1260 LINE (0, MIN8)-(BK%, MAX8),,B
1270 '  ..... draw horizontal lines
1280 FOR LN=MIN8 TO MAX8 STEP 64
```

```
1290 LINE (0,LN)-(BK%,LN),,,&HCCCC
1300 NEXT LN
1310 ' ..... draw vertical lines
1330 LINE (LN,MIN8)-(LN,MAX8),,,&HCCCC
1340 NEXT LN
1350 '
1360 LOCATE 5,2
1370 ' ..... draw the waveform for d8
1390 FOR I%=BS%+1 TO BC%
1400 LINE -(I%,WFME%(I%))
1410 NEXT I%
1420 ' ..... locate positions and print screen annotation
1430 '
1440 LOCATE 5,2:PRINT "DIG #6"
1450  IF OPER$="SCALE"  THEN LET VPD =  VS1*TF6
1460 LOCATE 6,2: PRINT VS1; "V/D"
1470 LOCATE 6,2:IF OPER$ ="SCALE" THEN PRINT VPD; "V/D"
1480 '
1490 LOCATE 17,2:PRINT "DIG #8
1500  IF OPER$="SCALE"  THEN LET APD =  VS2*TF8
1510 LOCATE 18,2: PRINT VS2; "V/D"
1520 LOCATE 18,2:IF OPER$ ="SCALE" THEN PRINT APD; "A/D"
1530 '
1540 LOCATE 1,10:PRINT (MAX6/64)*VS1;" V"
1550 LOCATE  1,10: IF OPER$="SCALE" THEN PRINT (MAX6/64)*VS1*TF6;" V"
1560 '
1570 '
1580 LOCATE 10,10:PRINT (MIN6/64)*VS1;" V"
1590 LOCATE  10,10: IF OPER$="SCALE" THEN PRINT (MIN6/64)*VS1*TF6;" V"
1600 LOCATE 13,10:PRINT (MAX8/64)*VS2;" V"
1610 LOCATE 13,10: IF OPER$="SCALE" THEN PRINT (MAX8/64)*VS2*TF8;" A"
1620 '
1630 LOCATE 22,10:PRINT (MIN8/64)*VS2;" V"
1640 LOCATE 22,10: IF OPER$="SCALE" THEN PRINT (MIN8/64)*VS2*TF8;" A"
1650 LOCATE 2,52:PRINT "DATA NAME : ";N6$
1660 LOCATE 4,52:PRINT "D.U.T. is ";DUT6$
1670 LOCATE 5,52:PRINT "Probe is ";PT6$
1680 LOCATE 6,52:PRINT "DISK #";DN6%;" TF=( * ";TF6;")"
1690 LOCATE 6,52: IF OPER$="SCALE" THEN PRINT "D#";DN6%;" SCALED
BY(*";TF6;")"
1700 LOCATE 7,52:PRINT "MAX= ";VMAX6;" V"
1710 LOCATE 7,52: IF OPER$="SCALE" THEN PRINT "MAX= ";VMAX6*TF6;" V   "
```

```
1720 LOCATE 8,52:PRINT "T of MAX=";INT(TMAX6/1E-09);" NS"
1730 LOCATE 9,52:PRINT "MIN= ";VMIN6;" V"
1740 LOCATE 9,52:IF OPER$="SCALE" THEN  PRINT "MIN= ";VMIN6*TF6;" V    "
1750 '
1760 LOCATE 14,52:PRINT "DATA NAME : ";N8$
1770 LOCATE 16,52:PRINT "D.U.T. is ";DUT8$
1780 LOCATE 17,52:PRINT "Probe is ";PT8$
1790 LOCATE 18,52:PRINT "DISK #";DN8%;" TF=( * ";TF8;")"
1800 LOCATE 18,52: IF OPER$="SCALE" THEN PRINT "D#";DN8%;" SCALED
BY(*";TF8;")"
1810 LOCATE 19,52:PRINT "MAX= ";VMAX8;" V"
1820 LOCATE 19,52:IF OPER$="SCALE" THEN PRINT  "MAX= ";VMAX8*TF8;" A    "
1830 LOCATE 20,52:PRINT "T of MAX=";INT(TMAX8/1E-09);" NS"
1840 LOCATE 21,52:PRINT "MIN= ";VMIN8;" V"
1850 LOCATE 21,52:IF OPER$="SCALE" THEN PRINT  "MIN= ";VMIN8*TF8;" A    "
1860 REM LOCATE 22,55:PRINT TF8$
1870 LOCATE 11,18:PRINT "   Above is ";HS1/1E-09;" NS/DIV"
1880 LOCATE 12,18:PRINT "   Below is ";HS2/1E-09;" NS/DIV"
1890 LOCATE 23,16:PRINT CM6$
1900 ' .....end of graph routine
1920 '
1930 REM
1940 IF INKEY$="" THEN 1940
1950 '
1960 LOCATE 23,15:PRINT " "
1970 '
1980 LOCATE 23,12
1990 PRINT " Options: (M)enu, (S)cale or (Z)oom this data, (G)raph another
2000 CH$="":CH$=INKEY$:IF CH$="" THEN 2000
2010 '
2020 IF CH$="M" OR CH$="m" THEN  CHAIN "menu79.ddt"
2030 IF CH$="G" OR CH$= 'g" THEN SCREEN 2,0:VIEW
2040 IF CH$="G" OR CH$="g" THEN LET OPER$=""
2050 IF CH$="G" OR CH$="g" THEN GOTO 630
2060 IF CH$="Z" OR CH$="z" THEN GOTO 2140
2070 IF CH$="S" OR CH$="s" THEN GOTO 2440
2080 SOUND 50,.5
2090 LOCATE 22,15:PRINT " "
2100 LOCATE 24,13
2110 PRINT " >>>>  ( M ) or ( G ) or ( Z ) , please       <<<< "
2120 GOTO 1990
2130 LOCATE 24,15:PRINT " "
```

```
2140 REM
2150 REM
2160 REM
2170 '
2180 LOCATE 23,12
2190 PRINT " ZOOM OPTION ... INPUT START TIME (nS) "
2200 LOCATE 23,57
2210 INPUT FRT:FRT=FRT* 1E-09
2220 '
2230 LOCATE 23,1:PRINT " "
2240 REM
2250 LOCATE 23,15
2260 PRINT "ZOOM OPTION ... NOW,  INPUT STOP TIME (nS) "
2270 LOCATE 23,47
2280 INPUT BKT:BKT=BKT* 1E-09
2290 IF FRT=>BKT  THEN LOCATE 24,15
2300 IF FRT=>BKT  THEN SOUND 50,.5
2310 IF FRT=>BKT  THEN PRINT " invalid zoom inputs; try again please "
2320 IF FRT=>BKT  THEN PRINT " HIT ANY KEY TO CONTINUE
2340 IF FRT=>BKT  THEN LOCATE 22,15:PRINT " "
2350 IF FRT=>BKT GOTO 2190
2360 TWA=HS1* 10 :TWB=HS2*10 '  the time windows
2370 REM
2380 LET FR%=(FRT/TWA)*LE6% ' the starting array point
2390 LET BK%=(BKT/TWA)*LE6% ' the ending array point
2400 EX%=1
2410 '
2420 GOTO 850 '  back to the graph routine
2430 STOP
2440 '  ..... the scale data sub-routine.....
2450 OPER$ = "SCALE"
2460 '
2470 GOTO 850  ' back to the graph routine
2480 ' ..... retrieve the data from the floppy disk, drive 'A`
2490 '
2500 LET FL$=F$(FLN)
2510 '
2520  LET N6$=KB$+":D6"+FL$
2530  LET N8$=KB$+":D8"+FL$
2540 '
2550 PRINT " Roger that, retrieving data files : ";N6$;" and ";N8$
2560 '
```

```
2570 CLOSE #1:CLOSE #2
2580 OPEN N6$ FOR INPUT AS #1
2590 IF EOF(1) THEN 2710
2600 INPUT
#1,LE6%,N6$,VS1,HS1,VMAX6,TMAX6,VMIN6,TI$,DA$,CM6$,TF6,TF6$,DN6%
2610 INPUT #1,DUT6$,PT6$
2620 IF NNT%=1 THEN ERASE WFMS%,WFME%
2630 DIM WFMS%(LE6%),WFME%(LE6%)      ' ..... dimension waveform arrays .....
2640 BC%=LE6%
2650 NNT%=1
2660 CT%=0
2670 FOR N = 0 TO LE6%
2680 INPUT #1,WFMS%(N)
2690 NEXT N
2700 CT%=LE6%
2710 CLOSE #1
2720 '
2730 OPEN N8$ FOR INPUT AS #2
2740 IF EOF(2) THEN 2710
2750 INPUT
#2,LE8%,N8$,VS2,HS2,VMAX8,TMAX8,VMIN8,TI$,DA$,CM8$,TF8,TF8$,DN8%
2760 INPUT #2,DUT8$,PT8$
2770 FOR N = 0 TO LE8%
2780 INPUT #2,WFME%(N)
2790 NEXT N
2800 CT%=CT%-1
2810 CLOSE #2
2820 REM ..... end of read-in data routine
2840 '  first, get back the array max and mins
2850 '
2860 RMX6=(VMAX6/VS1)*64
2870 RMX8=(VMAX8/VS2)*64
2880 RMN6=(VMIN6/VS1)*64
2890 RMN8=(VMIN8/VS2)*64
2900 RETURN
2910 N=1    '..... present all the files
2920 CLS:FR=FRE(0)
2930 PRINT
2940 R=3:C=1
2950 IF NF<=30 THEN SN=2
2960 IF NF>30 THEN SN=1
2970 LOCATE R,C,0
```

```
2980 FOR C=1 TO 61 STEP 22
2990 FOR R=3 TO 22 STEP SN
3000 LOCATE R,C
3010 IF  F$(N)= "" THEN 3060
3020 PRINT "(";N;") ";F$(N)
3030 N=N+1
3040 NEXT R
3050 NEXT C
3060 IF N>=NF THEN RETURN
3070 IF CNF>N-1 THEN SOUND 50,.5
3080 IF CNF>N-1 THEN PRINT " >> MORE FILES FOLLOW >> ";
3090  PRINT ".....HIT ANY KEY TO CONTINUE
3110 IF CNF>N-1 THEN GOTO 2920
3120 RETURN
3130 REM
```

Appendix G.—Shot-File Program

```
10 CLS:'      Appendix G : 'SHOT79.DDT' ..... jan 89    JJL
20 ON ERROR GOTO 0
30 SCREEN 0,2:COLOR 15,4,8
40 CLEAR:KEY OFF
50 PRINT: FOR N=1 TO 10:KEY(N) OFF:NEXT N    ' disable keys until text read
60 PRINT:PRINT
70 PRINT "    Shot file program ....."
80 PRINT:PRINT
90 PRINT "    Input the Drive letter where the shot file resides ( a,b or c )"
100 DL$=INKEY$ : IF DL$="" THEN 100
110 SF$=DL$+":shot79.fil"
120 '
130 ON ERROR GOTO 150
140 CLOSE #1:OPEN SF$ FOR INPUT AS #1
150 IF ERR = 76 THEN PRINT " ..... invalid drive entry....."
160 IF ERR = 76 THEN BEEP
170 IF ERR = 76 THEN RESUME 60
180 CLS:PRINT:PRINT
190 PRINT " Working..... reading the number of shot file entries ."
200 FOR N = 1 TO 4000
210 IF EOF(1) THEN 320
220 INPUT
#1,LE6%,N6$,VS1,HS1,VMAX6,TMAX6,VMIN6,TI$,DA$,CM6$,TF6,TF6$,DN%
230 INPUT #1,DUT6$,PT6$
240 INPUT
#1,LE8%,N8$,VS2,HS2,VMAX8,TMAX8,VMIN8,TI$,DA$,CM8$,TF8,TF8$,DN%
250 INPUT #1,DUT8$,PT8$
260 NUF = NUF +1
270 IF NUF >  500 THEN PRINT "  This file contains more than 500 entries."
280 IF NUF >  1000 THEN PRINT "  This file contains more than 1000 entries.
290 IF NUF >  2000 THEN PRINT "  This file contains more than 2000 entries.
300 IF NUF >  3000 THEN PRINT "  This file contains more than 3000 entries.
310 NEXT N
320 CLS:PRINT:PRINT
330 '
340 IF NUF > 3000 THEN BEEP
350 IF NUF > 3000 THEN PRINT " >>>  this file is too large and should be"
360 IF NUF > 3000 THEN PRINT " >>>  copied to a hi-density floppy , IF it"
370 IF NUF > 3000 THEN PRINT " >>>  came from the hard disk."
380 IF NUF<3000 THEN GOTO 420
390 PRINT:PRINT
400 IF NUF> 3000 THEN PRINT "      Hit any key to continue ."
```

```
410  IF INKEY$="" THEN 410
420 CLS:PRINT
430 PRINT "      The Shot file program .      Your options are :"
440 PRINT
450 PRINT "      key          option"
460 PRINT "      ---          ------"
470 PRINT
480 PRINT "      F1 ..... display the file on the screen"
490 PRINT
500 PRINT "      F2 ..... print the file "
510 PRINT
520 PRINT "      F3 ..... search for a specific file name"
530 PRINT
540 PRINT "      F4 ..... search for a particular word or phrase"
550 PRINT "                in the annotation."
560 PRINT
570 PRINT "      F5 ..... search for a specific device name"
580 PRINT
590 PRINT "      F6 ..... return to the main menu program"
600 PRINT
610 PRINT "      F7 ..... for some 'hints' on searching
620 PRINT
630 PRINT "      F8 ..... copy the shot file to a floppy disc
640 PRINT:PRINT "      your choice ?
650 REM
660 ON KEY(1) GOSUB 840     ' print shot file ( or one day ), to screen
670 REM
680 ON KEY(2) GOSUB 1360    ' print shot file ( or one day ), on Epson
690 REM
700 ON KEY(3) GOSUB 1830    ' search for a particular file
710 REM
720 ON KEY(4) GOSUB 2170    ' search annotations for word, phrase, etc
730 REM
740 ON KEY(5) GOSUB 2820    ' search for DUT
750 REM
760 ON KEY(6) GOSUB 2480    ' return to the Main menu program
770 REM
780 ON KEY(7) GOSUB 2570    ' give some hints on search procedure
790 REM
800 ON KEY(8) GOSUB 3050    ' copy the shot file to a floppy
810 REM
820 FOR N=1 TO 8:KEY(N) ON:NEXT N
```

```
830 GOTO 830
840 CLS:PRINT:PRINT
850 PRINT "          Do you wish to limit the display to a certain day  ?"
860 DS$=""
870 PRINT:PRINT "      'Y' or 'N' please
880 CH$="":DS$=""
890 '
900  CH$ = INKEY$: IF CH$= "" THEN 900
910 IF CH$="n" OR CH$="N" THEN 980
920 IF CH$="Y" OR CH$="y" THEN PRINT " Input the day for the data search."
930 PRINT
940 IF CH$="Y" OR CH$="y" THEN PRINT " EXAMPLE : 0/0487  is July 4, 1987"
950 PRINT
960 IF CH$="Y" OR CH$="y" THEN INPUT DS$
970 REM ..... routine to print the entire shot file
980 CLS: PRINT:PRINT "          THE SHOT FILE :"
990 CNPT=0
1000 CLOSE #1:OPEN SF$ FOR INPUT AS #1
1010 '
1020 PRINT
1030 CKF%=0
1040 FOR N = 1 TO NUF
1050 GOSUB 3860
1060 IF EOF(1) THEN 1260
1070 IF CH$="y" THEN CH$="Y"
1080 IF CH$="Y" AND MID$(N6$,3,6)=DS$ THEN CKF%=1
1090 IF CH$="Y" AND MID$(N6$,3,6)<>DS$ THEN GOTO 1220
1100 PRINT "  ";N6$;"  Disk # ";DN%;"   Vmax = ";VMAX6;" t.f. = *";TF6
1110 PRINT "  Device Under Test ( D.U.T.) : ";DUT6$;"  Probe = ";PT6$
1120 PRINT "  Annotation : ";CM6$
1130 PRINT "  ";N8$;"  Disk # ";DN%;"   Vmax = ";VMAX8;" t.f. = *";TF8
1140 PRINT "  Device Under Test ( D.U.T.) : ";DUT8$;"  Probe = ";PT8$
1150 PRINT "  Annotation : ";CM8$
1160 CNPT=CNPT + 1
1170 PRINT
1180 IF CNPT = 3 THEN PRINT "      HIT ANY KEY TO CONTINUE"
1190 IF CNPT = 3 THEN IF INKEY$="" THEN 1190
1200 IF CNPT = 3 THEN CLS
1210 IF CNPT = 3 THEN CNPT = 0
1220 NEXT N
1230 '
1240 PRINT"..... hit any key to continue ....."
```

```
1250 IF INKEY$="" THEN 1250
1260 IF EOF(1) THEN PRINT " End of shot file; Hit any key to continue."
1270 PRINT:PRINT
1280 IF DS$<>"" THEN IF CKF%=0 THEN PRINT "  NO DATA WITH DATE : ";DS$
1290 IF EOF(1) THEN IF INKEY$="" THEN 1290
1300 CLOSE #1:CLS:GOTO 420
1310 REM
1320 PRINT:PRINT " .....end of shot file.....
1330 '
1340 '
1350 '
1360 REM      ....line printer routine for shot file .....
1370 '
1380 '
1390 REM
1400 CLS:PRINT:PRINT
1410 FOR N=1 TO NUF:KEY(N) OFF:NEXT N
1420 PRINT "       Roger that, will print  shot file.
1430 PRINT:PRINT
1440 PRINT "       Do you wish to limit the print to a certain day  ?"
1450 PRINT:PRINT "      'Y` or 'N` please
1460 CP$="": CP$=INKEY$: IF CP$="" THEN 1460
1470 IF CP$="y"THEN CP$="Y"
1480 IF CP$="n"THEN CP$="N"
1490 IF CP$="Y" OR CP$="N" THEN GOTO 1520
1500 '
1510 GOTO 1440
1520 IF CP$="Y" THEN PRINT " input the day for the data search
1530 PRINT
1540 IF CP$="Y" THEN PRINT " EXAMPLE : 070487  is July 4, 1987"
1550 PRINT
1560 IF CP$="Y" THEN INPUT DS$
1570 PRINT
1580 PRINT " if the printer is ready then hit any key but 'M` to start."
1590 CH$="": CH$=INKEY$: IF CH$="" THEN 1590
1600 IF CH$="m" OR CH$="M" THEN 420
1610 I=1:J=20:LPRINT
1620 CLOSE #1:OPEN SF$ FOR INPUT AS #1
1630 LPRINT " .....SHOT FILE, DDT TESTING .....";TIME$;"   ";DATE$
1640 FOR N = 1 TO NUF
1650 GOSUB 3860
1660 IF EOF(1) THEN 2500
```

```
1670 IF CP$="Y" AND MID$(N6$,3,6)<>DS$ THEN GOTO 1770
1680 LPRINT
1690 LPRINT " ";N6$;" Disk # ";DN%;"  Vmax = ";VMAX6;" t.f. = *";TF6
1700 LPRINT " Device Under Test ( D.U.T.) : ";DUT6$;" Probe = ";PT6$
1710 LPRINT " Annotation : ";CM6$
1720 LPRINT
1730 LPRINT " ";N8$;" Disk # ";DN%;"  Vmax = ";VMAX8;" t.f. = *";TF8
1740 LPRINT " Device Under Test ( D.U.T.) : ";DUT8$;" Probe = ";PT8$
1750 LPRINT " Annotation : ";CM8$
1760 LPRINT
1770 NEXT N
1780 '
1790 LPRINT
1800 NEXT N
1810 GOTO 2500
1820 REM
1830 REM .... SEARCH FOR A SPECIFIC FILE NAME
1840 REM
1850 CLS: PRINT:PRINT "          Roger that, input the file name for search."
1860 INPUT SE$:CKF%=0
1870 CLOSE #1:OPEN SF$ FOR INPUT AS #1
1880 IF EOF(1) THEN 2140
1890 FOR N = 1 TO NUF
1900 GOSUB 3860
1910 '
1920 IF N=1 THEN PRINT:PRINT
1930 IF SE$=N6$ THEN PRINT "....."
1940 IF SE$=N6$ THEN PRINT
1950 IF SE$=N6$ THEN PRINT " ";N6$;"  Vmax = ";VMAX6;" t.f. = *";
1960 IF SE$=N6$ THEN PRINT TF6;"  Disk #";DN%;" D.U.T. is ";DUT6$
1970 IF SE$=N6$ THEN PRINT
1980 IF SE$=N6$ THEN PRINT " Annotation : ";CM6$
1990 IF SE$=N6$ THEN PRINT
2000 IF SE$=N6$ THEN CKF%=1
2010 IF SE$=N8$ THEN CKF%=1
2020 IF SE$=N6$ THEN PRINT "....."
2030 IF SE$=N6$ THEN GOTO 2500
2040 IF SE$=N8$ THEN PRINT "....."
2050 IF SE$=N8$ THEN PRINT
2060 IF SE$=N8$ THEN PRINT " ";N8$;"  Vmax = ";VMAX8;" t.f. = *";
2070 IF SE$=N8$ THEN PRINT TF8;"  Disk #";DN%;" D.U.T. is ";DUT8$
2080 IF SE$=N8$ THEN PRINT
```

```
2090 IF SE$=N8$ THEN PRINT "  Annotation : ";CM8$
2100 IF SE$=N8$ THEN PRINT "....."
2110 IF SE$=N8$ THEN GOTO 2500
2120 NEXT N
2130 'IF CKF=0 THEN PRINT "          COULD NOT FIND : ";SE$
2140 IF EOF(1) THEN PRINT "      End of shot file."
2150 GOTO 2500
2160 REM .....SEARCH FOR WORD OR PHRASE IN SHOT FILE
2170 CLS: PRINT "      Input the word or phrase for the search "
2180 PRINT:PRINT "      Remember, the word or phrase must have been filed
2190 PRINT "    as a comment when the data was collected."
2200 PRINT:PRINT "    Also, it must be the exact word (or phrase).
2210 REM
2220 PRINT:PRINT "    EXAMPLES :
2230 PRINT:PRINT "    if you input  'diode` you will not find  'diode `
2240 PRINT
2250 PRINT "      For any input word or phrase, don't use unnecessary spaces.
2260 SE$="":INPUT SE$
2270 GOSUB 3500 '  CAPS ROUTINE
2280 REM
2290 LET FRONT%=1:LET LAST%=LEN(SE$)
2300 PRINT:PRINT
2310 PRINT "          searching for :  ";SE$
2320 PRINT:PRINT
2330 CLOSE #1:OPEN SF$ FOR INPUT AS #1
2340 CKF%=0
2350 FOR N=1 TO NUF
2360 GOSUB 3860
2370 FOR S=1 TO LEN(CM6$)
2380 IF MID$(CM6$,FRONT%,LAST%)=SE$ THEN PRINT "  ";N6$;"  CONTAINS  ";SE$
2390 IF MID$(CM6$,FRONT%,LAST%)=SE$ THEN CKF%=1
2400 '
2410 IF MID$(CM8$,FRONT%,LAST%)=SE$ THEN PRINT "  ";N8$;"  CONTAINS  ";SE$
2420 IF MID$(CM8$,FRONT%,LAST%)=SE$ THEN CKF%=1
2430 FRONT%=FRONT%+1
2440 NEXT S
2450 FRONT%=1:LAST%=LEN(SE$)
2460 NEXT N
2470 GOTO 2510
2480 REM .... RETURNING TO MAIN MENU
2490 CHAIN "MENU79.DDT"
2500 REM wait routine, then return
```

```
2510 PRINT:PRINT " >>>      HIT ANY KEY TO CONTINUE      <<<
2520 PRINT:PRINT
2530 IF CKF%=0 THEN PRINT " Note: could not find ";SE$
2540 IF INKEY$="" THEN 2540
2550 CLS:GOTO 420
2560 '
2570 REM .....some hints on searching.....
2580 '
2590 CLS:FOR N=1 TO 10:KEY(N) OFF:NEXT N:CKF%=1
2600 PRINT:PRINT "       Some hints on how to search the shot file
2610 PRINT:PRINT
2620 PRINT "         Every time data was collected through the DDT
2630 PRINT "     programs, the opportunity was present to file descriptive
2640 PRINT "     annotation with the data. If this annotation was done, the
2650 PRINT "     'shot file` contains a copy of whatever text was input.
2660 PRINT
2670 PRINT "      This program may be useful to you, in that you may search
2680 PRINT "    through all of this annotation for each occurance of a given
2690 PRINT "    word or phrase. For instance, you might wish to know what
2700 PRINT "    data was filed for a particular device. If that device name
2710 PRINT "    was input during the data annotation, then you can find the
2720 PRINT "    file name and disc number with this program.
2730 PRINT
2740 PRINT "      The key is to input exactly the same text, or even part
2750 PRINT "    of the text. As an example, if you input 'device 104` and
2760 PRINT "    the original entry was 'dev 104` , the search will be fruitless.
2770 PRINT "    If however, you input only the numbers ' 104 ` then you would
2780 PRINT "    be sucessful. It is best to be concise.
2790 GOTO 2500
2800 STOP
2810 '
2820 REM ..... search the for a device name .....
2830 '
2840 CLS
2850 PRINT:PRINT "       Roger, Input the device name for search : "
2860 PRINT
2870 SE$="":INPUT SE$
2880 PRINT:PRINT
2890 '
2900 GOSUB 3340 ' CAP ROUTINE
2910 PRINT "       searching for : ";SE$
2920 '
```

```
2930 PRINT:PRINT
2940 CKF%=0
2950 CLOSE #1:OPEN SF$ FOR INPUT AS #1
2960 FOR N=1 TO NUF
2970 GOSUB 3860
2980 IF SE$=DUT6$ THEN PRINT "  ";N6$;"  CONTAINS DEVICE  ";SE$
2990 IF SE$=DUT6$ THEN CKF%=1
3000 IF SE$=DUT8$ THEN PRINT "  ";N8$;"  CONTAINS DEVICE  ";SE$
3010 IF SE$=DUT8$ THEN CKF%=1
3020 NEXT N
3030 '
3040 GOTO 2510 ' wait routine
3050 CLS
3060 PRINT:PRINT
3070 PRINT "       ROUTINE TO COPY THE SHOT FILE
3080 PRINT
3090 PRINT "       ********** CAUTION **********
3100 PRINT
3110 PRINT "    IF A SHOT FILE IS PRESENT ON THE FLOPPY YOU INTEND TO USE
3120 PRINT "       THIS ROUTINE WILL OVER-WRITE IT.
3130 PRINT
3140 PRINT "       **********************************************"
3150 BEEP
3160 PRINT
3170 PRINT "       IF THE FLOPPY IS READY IN DRIVE `A` , HIT `Y`
3180 PRINT
3190 PRINT "       TO RETURN TO `SHOT FILE` MENU, WITHOUT COPYING, HIT `N`
3200 CH$="":CH$=INKEY$:IF CH$="" THEN 3200
3210 IF CH$="N" OR CH$="n" THEN 420
3220 IF CH$="y" THEN CH$= "Y"
3230 IF CH$="Y" THEN GOTO 3250
3240 PRINT "..... ( y )  or  ( n)  please .....":GOTO 3160
3250 SHELL "copy c:shot79.fil a:shot79.fil"
3260 PRINT:PRINT
3270 PRINT
3280 PRINT "file copied; directory of file is below.
3290 PRINT
3300 FILES "a:shot79.fil"
3310 PRINT " .....copy complete, returning to `shot menu`
3320 FOR N=1 TO 2000:N=N:NEXT N   ' delay to read message
3330 GOTO 50
3340 REM ..... routine to capatilize all letters in the DUT
```

```
3350 ST$=SE$
3360 LET LST=LEN(ST$)
3370 FOR N=1 TO LST
3380 LET L$=MID$(ST$,N,1)
3390 IF ASC(L$)=>97 THEN IF ASC(L$)<=122 THEN GOSUB 3440
3400 NEXT N
3410 SE$=ST$
3420 RETURN
3430 STOP
3440 LET FRONT$=MID$(ST$,1,N-1)
3450 LET REAR$=MID$(ST$,N+1,LST)
3460 LET NV=ASC(L$)-32
3470 LET L$=CHR$(NV)
3480 LET ST$=FRONT$+L$+REAR$
3490 RETURN
3500 REM ..... routine to capatilize all letters in the ANNOTATION
3510 LET ST$=SE$
3520 LET LST=LEN(ST$)
3530 FOR N=1 TO LST
3540 LET L$=MID$(ST$,N,1)
3550 IF ASC(L$)=>97 THEN IF ASC(L$)<=122 THEN GOSUB 3600
3560 NEXT N
3570 LET SE$=ST$
3580 RETURN
3590 STOP
3600 LET FRONT$=MID$(ST$,1,N-1)
3610 LET REAR$=MID$(ST$,N+1,LST)
3620 LET NV=ASC(L$)-32
3630 LET L$=CHR$(NV)
3640 LET ST$=FRONT$+L$+REAR$
3650 RETURN
3660 REM ..... to make all capital letters in the probe type .....
3670 IF PT6$<>"" AND PT8$="" THEN LET ST$=PT6$
3680 IF PT6$<>"" AND PT8$<>"" THEN LET ST$=PT8$
3690 LET LST=LEN(ST$)
3700 FOR N=1 TO LST
3710 LET L$=MID$(ST$,N,1)
3720 IF ASC(L$)=>97 THEN IF ASC(L$)<=122 THEN GOSUB 3780
3730 NEXT N
3740 IF PT6$<>"" AND PT8$="" THEN LET PT6$=ST$
3750 IF PT6$<>"" AND PT8$<>"" THEN LET PT8$=ST$
3760 RETURN
```

```
3770 STOP
3780 LET FRONT$=MID$(ST$,1,N-1)
3790 LET REAR$=MID$(ST$,N+1,LST)
3800 LET NV=ASC(L$)-32
3810 LET L$=CHR$(NV)
3820 LET ST$=FRONT$+L$+REAR$
3830 RETURN
3840 '
3850 '
3860 'IF EOF(1) THEN 1280
3870 INPUT
#1,LE6%,N6$,VS1,HS1,VMAX6,TMAX6,VMIN6,TI$,DA$,CM6$,TF6,TF6$,DN%
3880 INPUT #1,DUT6$,PT6$
3890 INPUT
#1,LE8%,N8$,VS2,HS2,VMAX8,TMAX8,VMIN8,TI$,DA$,CM8$,TF8,TF8$,DN%
3900 INPUT #1,DUT8$,PT8$
3910 RETURN
3920 CLOSE #1:STOP
```

Appendix H.—Data Diskette Numbering Program

```
10 ' ..... APPENDIX H : NUMDSK79.DDT ..... JAN 88 /JJL
20 CLS:SCREEN 0,2:COLOR 15,9,8:CLEAR
30 PRINT:PRINT:PRINT
40 PRINT "          PROGRAM NAME : 'NUMDISK.DDT` 11 SEPT 87 JJL"
50 ON ERROR GOTO 0
60 PRINT:PRINT
70 '
80 PRINT "        CHECKING TO SEE IF DISK ALREADY IS NUMBERED"
90 ON ERROR GOTO 160
100 FILES "A:DISKNUM.*"
110 PRINT:PRINT
120 PRINT "     >>>> DISK IS ALREADY NUMBERED AS SEEN BELOW <<<<"
130 GOSUB 700
140 GOTO 660
150 STOP
160 IF ERR=71 THEN BEEP
170 PRINT
180 IF ERR=71 THEN PRINT "        DISK MISSING OR DOOR OPEN ON DRIVE 'A`"
190 PRINT
200 IF ERR=71 THEN PRINT "        CORRECT THIS CONDITION PLEASE"
210 PRINT
220 IF ERR=71 THEN PRINT "        >> HIT ANY KEY WHEN DONE <<"
230 IF ERR=71 AND INKEY$="" THEN 230
240 IF ERR=71 THEN RESUME 20
250 PRINT: PRINT "   NO DISK NUMBER FOUND; DISK NUMBERS ALREADY USED
ARE:"
260 PRINT
270 DIM DR%(200)
280 CLOSE #1:OPEN "NUMBERS.DSK" FOR INPUT AS #1
290 FOR N=0 TO 200
300 IF EOF(1) THEN 360
310 INPUT #1,DR%(N)
320 IF DR%(N)=0 THEN 350
330 IF NHN<DR%(N) THEN LET NHN=DR%(N)
340 PRINT DR%(N);" ";
350 NEXT N
360 CLOSE #1
370 NN%=N
380 PRINT
390 PRINT:PRINT "     THE NEXT DISK NUMBER SHOULD BE : ( ";NHN+1;" )
400 PRINT:PRINT "     INPUT A NUMBER FOR THIS DISC  ( 1  to 999 )
410 INPUT EXT$:DN%=VAL(EXT$)
```

```
420 IF VAL(EXT$)<1 OR VAL(EXT$)>999 THEN PRINT EXT$; " out of range"
430 IF VAL(EXT$)<1 OR VAL(EXT$)>999 THEN GOTO 400
440 IF VAL(EXT$)<10 THEN EXT$="00"+EXT$
450 IF VAL(EXT$)<10 THEN GOTO 470
460 IF VAL(EXT$)<100 THEN EXT$="0"+EXT$
470 FOR N=1 TO 200      'check to see not using a number already used
480 IF DN%=DR%(N) THEN GOSUB 840
490 NEXT N
500 IF DN%<>NHN+1 THEN GOSUB 900
510 PRINT:PRINT "       NOW, INPUT ANY COMMENT YOU WANT ABOUT THIS
DISK."
520 INPUT CM$
530 PRINT "             .....date and time will be auto-filed.....
540 CLOSE #1:CLOSE #2
550 FL$="DISKNUM.DDT"
560 FL$="A:"+FL$
570 CLOSE #1
580 OPEN FL$ FOR OUTPUT AS #1
590 OPEN "NUMBERS.DSK" FOR APPEND AS #2
600 DA$=DATE$:TI$=TIME$
610 WRITE #1,FL$,CM$,DA$,TI$,DN%
620 WRITE #2,DN%
630 CLOSE #1:CLOSE #2
640 CLS:PRINT:PRINT :PRINT "        DISK NUMBERED AS SEEN BELOW : "
650 PRINT:PRINT:FILES FL$
660 PRINT:PRINT "       RETURN TO MAIN MENU BY HITTING ANY KEY "
670 IF INKEY$="" THEN 670
680 CHAIN "MENU79.DDT"
690 END
700 REM .....A ROUTINE TO READ IT BACK
710 CLOSE #1
720 FL$="A:DISKNUM.DDT"
730 OPEN FL$ FOR INPUT AS #1
740 INPUT #1,FL$,CM$,DA$,TI$,DN%
750 CLOSE #1
760 PRINT:PRINT
770 PRINT "       ";FL$
780 PRINT "       COMMENT : ";CM$
790 PRINT "       DATE : ";DA$
800 PRINT "       TIME : ";TI$
810 PRINT "       AND DISC NUMBER IS ( ";DN%;" )"
820 RETURN
```

```
830 CLOSE #1
840 REM .... CATCH A REPEAT NUMBER
850 PRINT "          **********":BEEP
860 PRINT "UH OH ..... NUMBER ( ";DN%;" ) HAS BEEN USED BEFORE.
870 PRINT:PRINT " HIT ANY KEY TO TRY AGAIN "
880 IF INKEY$="" THEN 880
890 GOTO 20
900 REM .... ASK WHY NEXT CONSECUTIVE NUMBER NOT USED
910 PRINT "     ********** ":BEEP
920 PRINT
930 PRINT "     The next consecutive number should have been : ( ";NHN+1;" )
940 PRINT
950 PRINT "     You have input the number : ( ";DN%;" )
960 PRINT
970 PRINT "     If you wish the disk to have the number, input ' Y `
980 PRINT
990 PRINT "    If not, input ' N `
1000 CH$="":CH$=INKEY$:IF CH$="" THEN 1000
1010 IF CH$="n" OR CH$="N" THEN GOTO 20
1020 IF CH$="y" OR CH$="Y" THEN RETURN
1030 PRINT
1040 PRINT "          'Y` or 'N` PLEASE
1050 GOTO 920
```

Appendix I.—Data Diskette Copying Program

```
10 CLS:PRINT:PRINT "      PROGRAM NAME : 'COPYDAT.DDT'          MAY 87 jj
20 CLEAR:ON ERROR GOTO 1000
30 PRINT:PRINT
40 PRINT "    PURPOSE :  To make a back up copy of the disc in drive 'A'.
50 PRINT:PRINT
60 PRINT "    METHOD :  On command, this program will copy all files
70 PRINT "           from the disc in drive 'A' to a temporary master
80 PRINT "           file on the hard disc ( drive 'C' ).
90 PRINT
100 PRINT "           On the next command, it will write the files back
110 PRINT "           to drive 'A', where you will have placed a blank
120 PRINT "           formatted disc. The temporary file is deleted.
130 PRINT
140 PRINT "    OPTIONS :  (1) COMMENCE COPY PROCEDURE
150 PRINT "           (2) RETURN TO MAIN MENU
160 PRINT:PRINT "     INPUT YOUR CHOICE PLEASE, NUMBER KEY ' 1 ' or ' 2 '
170 INPUT CH%
180 PRINT
190 IF CH%=2 THEN CHAIN "menu.ddt"
200 IF CH%<>1 THEN PRINT "      Number key (1)  or (2) please
210 IF CH%<>1 THEN GOTO 130
220 CLS
230 FILES "A:
240 PRINT:PRINT "         ROGER THAT, COPY PROCEDURE. ABOVE IS DIRECTORY
250 PRINT "         OF DISC IN DRIVE  'A' .
260 PRINT:PRINT "     OPTIONS : (1)   CONTINUE
270 PRINT "           (2)   RETURN TO MAIN MENU
280 PRINT "           (3)   START OVER
290 PRINT:PRINT "  INPUT YOUR CHOICE PLEASE, NUMBER KEY  '1' or '2' or '3'
300 INPUT CH%
310 PRINT
320 IF CH%=2 THEN CHAIN "menu.ddt"
330 IF CH%=3 THEN GOTO 10
340 IF CH%<>1 THEN PRINT "      Number key (1) or (2) or (3) please
350 IF CH%<>1 THEN GOTO 240
360 CLS:PRINT:PRINT "    ONE MOMENT PLEASE WHILE FILE IS PREPARED ON 'C'
DISC.
370 SHELL "CD\TEMPO.DDT"
380 CLS
390 PRINT:PRINT "      FILES BEING TRANSFERRED :
400 SHELL "COPY A:*.* C:*.*"
410 CLS
```

```
420 PRINT:PRINT "       TRANSFER COMPLETE
430 PRINT:PRINT
440 PRINT "     REPLACE THE DATA DISC IN DRIVE 'A` WITH THE BLANK
450 PRINT "     DISC THAT YOU INTEND TO RECEIVE THE COPIED DATA :
460 PRINT:PRINT
470 PRINT "     >>> HIT ANY KEY WHEN DONE <<<
480 IF INKEY$="" THEN 480
490 PRINT:PRINT "       FILES BEING COPIED :
500 SHELL "COPY C:*.* A:*.*"
510 CLS
520 KILL "c:*.*
530 SHELL "CD\GURU"
540 CLS:PRINT:PRINT
550 PRINT "  TRANSFER COMPLETE ; DIRECTORY OF DISC IN DRIVE 'A` :
560 FILES "A:
570 PRINT:PRINT
580 PRINT "         OPTIONS : (1)  COPY ANOTHER DISC
590 PRINT "                   (2)  RETURN TO THE MAIN MENU
600 PRINT:PRINT
610 PRINT "       INPUT  '1` or '2` from the number keys please
620 INPUT CH%
630 IF CH%=2 THEN LOAD "MENU.DDT",R
640 IF CH%<>1 THEN PRINT "        ' 1 `  or  ' 2 `  please
650 IF CH%<>1 THEN GOTO 570
660 GOTO 10
1000 REM ..... error handler
1010 CLS:PRINT:PRINT "        AN ERROR HAS OCCURRED    "
1020 PRINT:PRINT
1030 IF ERR=71 THEN PRINT "       the disc in drive 'a` is not ready
1040 IF ERR=70 THEN PRINT "       the disc is write protected
1050 IF ERR=57 THEN PRINT "       an I/O error has occurred; see manual
1060 IF ERR=61 THEN PRINT "       the disc is full
1070 IF ERR=72 THEN PRINT "       disc media error; see manual
1080 IF ERR=51 THEN PRINT "       internal basic error; big trouble
1090 IF ERR=53 THEN PRINT "       file not found where expected
1100 IF ERR=67 THEN PRINT "       too many files
1990 PRINT:PRINT "      >> HIT ANY KEY TO CONTINUE <<
2000 IF INKEY$="" THEN 2000
2010 RESUME 10
```

Appendix J.—Power Computation Program

Pow

```
10 REM .....POWER79.DDT..... sept 89 .....JJL
15 '    outside version of program
20 SCREEN 0,0:SCREEN 2,0:KEY OFF:FOR N=1 TO 10:KEY(N)OFF:NEXT N
30 CLS:SCREEN 0,2:COLOR 15,7,8:CLS
40 CLEAR,,4000:DIM F$(250)
50 '
60 PRINT:PRINT "     Calculate Power for 7912 Data.....sep 89 /JJL"
70 PRINT:PRINT "  PURPOSE :  To retrieve disk stored 7912 data, present"
80 PRINT:PRINT "           it on the monitor, along with the I * E product."
90 PRINT:PRINT "  OPTIONS :  Input the drive letter (a,b, or c) where";
100 PRINT " the data is stored ."
110 PRINT:PRINT "           Input ( M ) to return to menu."
120 REM
130 CH$="":CH$=INKEY$:IF CH$="" THEN 130
140 IF CH$="m" OR CH$="M" THEN CHAIN "menu79.ddt"
150 IF CH$="a" THEN CH$="A"
160 IF CH$="b" THEN CH$="B"
170 IF CH$="c" THEN CH$="C"
180 IF CH$="A" OR CH$="B" OR CH$="C" THEN GOTO 240
190 PRINT:PRINT "  INPUT MUST BE  ( A , B , C , or M ) PLEASE."
200 PRINT:PRINT
210 SOUND 50,5
220 GOTO 90
230 REM
240 REM ..... purpose: find all 7912 files on a disk and make a directory
250 REM ..... 7912 files begin with 'CA' or CB, but are filed as sets
260 REM
270 CLS:PRINT:PRINT
280 PRINT "        SEARCHING DRIVE : ";CH$;" FOR 7912 DATA "
290 REM
300 KB$=CH$
305 IF CH$="C" THEN GOTO 330   ' outside program version
310 ON ERROR GOTO 2710
320 CHDIR KB$+":\"
330 LET DR$="dir "+KB$+": |sort>c:sort79.dir"
340 REM
350 SHELL DR$
360 CLOSE #1
370 CNF=1
380 OPEN "c:sort79.dir" FOR INPUT AS #1
390 FOR N=1 TO 250
400 IF EOF(1)= -1 THEN 450
410 INPUT #1,B$
420 IF MID$(B$,1,2)="D6" THEN LET F$(CNF)=MID$(B$,3,6)+"."+MID$(B$,10,3)
430 IF MID$(B$,1,2)="D6" THEN LET CNF=CNF+1
440 NEXT N
450 CLOSE #1
460 REM
470 PRINT:PRINT
480 IF CNF<>1 THEN GOTO 540
490  PRINT "    COULD NOT FIND ANY DATA WHERE THE FILE NAMES "
```

```
500 PRINT "     BEGIN WITH ' D6 ' FOR 'DIGITIZER 6 '."
510 PRINT "     HIT ANY KEY TO CONTINUE "
520 IF INKEY$="" THEN 520
530 GOTO 20
540 PRINT:PRINT "..... WORKING ....."
550 REM
560 REM
570 REM
580 CLS
590 REM
600 REM
610 REM .....to graph 7912 data in black & white (BW)
620 SCREEN 2,0:VIEW:CLS:KEY OFF
630 ON ERROR GOTO 0
640 REM ..... 
650 REM
660 CLS
670 REM ..... 
680 REM
690 REM ..... program to retrieve and graph DDT data .....
700 PRINT
710 GOSUB 2490          'present the files
720 '
730 LOCATE 23,1
740 PRINT "     A directory of 7912 data files on disk ";KB$;" is above."
750 '
760 LOCATE 24,1
770 PRINT "INPUT ONE FILE NUMBER OF THE SET TO BE GRAPHED or 'ZERO` to RE-
TURN";
780 PRINT " to MAIN MENU
790 REM
800 '
810 INPUT FLN
820 IF FLN=0  THEN CHAIN "menu79.DDT"
830 CLS:GOSUB 2100        '     read data from disk
840  LET FR%=0:LET BK%=LE6%   ' set window values, maybe changed in zoom-sub
850 REM
860 REM
870 SCREEN 2,0:VIEW:CLS              'set up & clear hi res graphics scree
880 REM
890 DEF SEG                    'restore SEG for IBM Color/Graphics
900 REM
910 VIEW:CLS                    'clear screen
920 REM
930 IF LEN(CM6$)<=60 THEN GOTO 950
940 LOCATE 23,15:PRINT MID$(CM6$,61,120)
950 REM ..... set up window for the waveforms .....
960 REM
970 VIEW (120,0)-(400,70)
980 GOSUB 2810
990 ' ..... determine which waveform window to use ( the larger)
1000 '
```

```
1010 IF MAXA=>MAXB THEN LET WMAX = MAXA
1020 IF MAXB=>MA`    THEN LET WMAX = MAXB
1030 IF MINA=<MIN.  .HEN LET WMIN = MINA
1040 IF MINB=<MINA THEN LET WMIN = MINB
1050 WINDOW (FR%,WMIN)-(BK%,WMAX)
1060 REM ..... draw border .....
1070 LINE (0,-512)-(CT%, 512),,B
1080 REM ..... draw horizontal lines .....
1090 FOR LN=WMIN TO WMAX STEP 64
1100 LINE (0,LN)-(LE6%,LN),,,&HCCCC
1110 NEXT LN
1120 REM
1130 REM ..... draw vertical lines .....
1140 REM
1150 FOR LN=FR% TO  BK% STEP (BK% - FR%)/10
1160 LINE (LN,-254)-(LN, 254),,,&HAAAA
1170 NEXT LN
1180 REM
1190 LOCATE 5,2
1200 REM
1210 REM ..... draw the waveforms .....
1220 ' ....      draw waveform from D6 .....
1230 LINE (BS%,WFMS%(BS%))-(BS%,WFMS%(BS%))
1240 FOR I%=BS%+1 TO LE6%
1250 LINE -(I%,WFMS%(I%))
1260 NEXT I%
1270 ' ....      draw waveform from D8 .....
1280 REM
1290 LINE (BS%,WFME%(BS%))-(BS%,WFME%(BS%))
1300 FOR I%=BS%+1 TO LE6%
1310 LINE -(I%,WFME%(I%))
1320 NEXT I%
1330 '
1340 REM ..... print the screen annotation with the graph .....
1350 LOCATE 4,2:PRINT "DIG. 6 & 8"
1360 LOCATE 6,2:PRINT VS1*TF6;"V/D"
1370 LOCATE 8,2:PRINT VS2*TF8;"A/D"
1380 LOCATE 2,55:PRINT "DATA NAME : ";N6$
1390 LOCATE 3,55:PRINT " D.U.T. is :"
1400 LOCATE 4,55:PRINT DUT6$
1410 LOCATE 5,55:PRINT "Probes: ";PT6$;" / ";PT8$
1420 LOCATE 6,55:PRINT "T.F.'s: ";TF6;" / ";TF8
1430 LOCATE 7,55:PRINT "Disk #";DN6%
1440 LOCATE 8,55:PRINT "(V)MAX= ";VMAX6;" V"
1450 LOCATE 9,55:PRINT "(I)MAX= ";VMAX8;" A"
1460 'LOCATE 10,55:PRINT MID$(CM6$,1,30)
1470 'LOCATE 11,55:PRINT MID$(CM6$,31,30)
1480 REM
1490 LOCATE 10,20
1500 TW = HS1 * 10
1510 '  hsi  ( horizontal sampling interval) used later in time shift cal.
1520 HSI = (HS1*10)/LE6%
```

```
1530 IF EX%=0 THEN PRINT  "TIME WINDOW : "; TW/1E-09;" nS"
1540 IF EX%=1 THEN PRINT  "TIME WINDOW : "; (TW-(TDIV*HS1))/1E-09;" nS"
1550 '     if expanded time, show expansion
1560 IF EX%=1 THEN LOCATE 12,20
1570 IF EX%=1 THEN PRINT " Window from T=";(TDIV*HS1)/1E-09;"to";TW/1E-09;" nS"
1580 REM
1590 T=0:P=0
1600 IF EX%=1 THEN GOTO 1720
1610 TIMEDIV=TW/10:DIVTWO=2*TIMEDIV
1620 LOCATE 13,10:PRINT "Input horizontal division where power calculations "
1630 LOCATE 15,10:PRINT "will begin. Calculations by this program suggest ";BLP
1640 LOCATE 17,10:PRINT "divisions as the point of baseline departure."
1650 INPUT TDIV '  the horizontal division
1660 FRT=TDIV*(LE6%/10)  ' this gives front or beginning array point
1670 IF EX%=0 THEN GOTO 3290
1680  LOCATE 14,10:PRINT "                                    "
1690 FOR N = 1 TO 20:KEY(N)OFF:NEXT N
1700 'T = T / 1E-09 : T = CINT(T) : T = T * 1E-09
1710 IF T<=.0000001 THEN GOTO 1740
1720  LOCATE 14,10:PRINT " Time = ";T/.000001;" uS"
1730 IF T >.0000001 THEN GOTO 1760
1740  LOCATE 14,10:PRINT " Time = ";T/1E-09;" nS"
1750 '
1760 FM=FRE(S$)
1770 VT = (WFMS%(FR%+P)/64)*VS1*TF6
1780 LOCATE 15,1:PRINT "                                    "
1790 LOCATE 15,10:PRINT " V(t) = "; VT   'instantaneous voltage
1800 '
1810 IT = (WFME%(FR%+P)/64)*VS2*TF8
1820 LOCATE 16,1:PRINT "                                    "
1830 LOCATE 16,10:PRINT " I(t)= ";IT     'instantaneous current
1840 '
1850 LOCATE 17,10:PRINT "                                   "
1860 PT = VT * IT
1870 LOCATE 17,10:PRINT " P(t)= ";PT     ' instantaneous power
1880 LOCATE 15,35:PRINT "                                   "
1890 LOCATE 16,35:PRINT "                                   "
1900 LOCATE 17,35:PRINT "                                   "
1910 LOCATE 18,35:PRINT "                                   "
1920 REM
1930 MOVE$=""
1940 LOCATE 20,10
1950 PRINT "  OPTIONS:  (S)hift cursor to stop point then (or)"
1960 LOCATE 21,10
1970 PRINT "          (F5) To start power calculations,"
1980 LOCATE 22,10
1990 PRINT "          (F1) to re-start program, or (F10) to exit to Menu."
2000 ON KEY(10) GOSUB 4060
2010 ON KEY(5) GOSUB 3740
2020 ON KEY(1) GOSUB 4030
2030 KEY(1)ON:KEY (10)ON:KEY(5)ON
2040 IF CH$="S" OR CH$="s" THEN RETURN
```

```
2050 CH$="":CH$=INKEY$:IF CH$="" THEN 2050
2060 IF CH$="s" OR CH$="S" THEN GOSUB 3380
2070 GOTO 1680
2080 STOP
2090 EX%=0
2100 REM
2110 REM ..... retrieve the data from the floppy disk, drive 'A` .....
2120 REM
2130 LET FL$=F$(FLN)
2140 REM
2150 '
2160  LET N6$=KB$+":D6"+FL$
2170  LET N8$=KB$+":D8"+FL$
2180 REM
2190 GOSUB 2500            'check for file name error
2200 REM
2210 PRINT " Roger that, retrieving data files : ";N6$;" and ";N8$
2220 CLOSE #1:CLOSE #2
2230 REM
2240 REM
2250 OPEN N6$ FOR INPUT AS #1
2260 IF EOF(1) THEN 2360
2270 INPUT
#1,LE6%,N6$,VS1,HS1,VMAX6,TMAX6,VMIN6,TI$,DA$,CM6$,TF6,TF6$,DN6%
2280 INPUT #1,DUT6$,PT6$
2290 IF NPP%=1 THEN ERASE WFMS%,WFME%
2300 DIM WFMS%(LE6%),WFME%(LE6%)      ' ..... dimension waveform arrays .....
2310 NPP%=1
2320 CT%=0
2330 INPUT #1,WFMS%(CT%)
2340 CT%=CT%+1
2350 IF CT%<=LE6% THEN 2330
2360 CLOSE #1
2370 OPEN N8$ FOR INPUT AS #2
2380 IF EOF(2) THEN 2360
2390 INPUT
#2,LE8%,N8$,VS2,HS2,VMAX8,TMAX8,VMIN8,TI$,DA$,CM8$,TF8,TF8$,DN8%
2400 INPUT #2,DUT8$,PT8$
2410 CT%=0
2420 INPUT #2,WFME%(CT%)
2430 CT%=CT%+1
2440 IF CT%<=LE8% THEN 2420
2450 CT%=CT%-1:BC%=511
2460 CLOSE #2
2470 REM ..... end of read-in data routine .....
2480 RETURN
2490 N=1    '..... present all the files
2500 CLS:FR=FRE(0)
2510 PRINT
2520 R=3:C=1
2530 IF CNF<=29 THEN SN=2
2540 IF CNF=>30 THEN SN=1
```

```
2550 LOCATE R,C,0
2560 FOR C=1 TO 61 STEP 22
2570 FOR R=3 TO 22 STEP SN
2580 LOCATE R,C
2590 IF  F$(N)= "" THEN 2640
2600 PRINT "(";N;") ";F$(N)
2610 N=N+1
2620 NEXT R
2630 NEXT C
2640 IF N>=CNF THEN RETURN
2650 IF CNF>N-1 THEN SOUND 50,.5
2660 IF CNF>N-1 THEN PRINT " >> MORE FILES FOLLOW >> ";
2670  PRINT ".....HIT ANY KEY TO CONTINUE ....."
2680 CH$=INKEY$:IF CH$="" THEN 2680
2690 IF CNF>N-1 THEN GOTO 2500
2700 RETURN
2710 IF ERR=71 THEN PRINT "  There should be a DDT data disk in drive ";CH$
2720 STOP
2730 PRINT
2740 IF ERR=71 THEN PRINT "  Please check drive ";CH$;" ;HIT ANY KEY WHEN DONE
2750 PRINT
2760 IF INKEY$="" THEN 640
2770 RESUME 30
2780 END
2790 IF INKEY$="" THEN 640
2800 REM .....
2810 ' to set up the window, we need the max and min found in the
2820 ' time window selected.
2830 TMAXA=0:TMAXB=0:MAXA=0:MINA=0:MAXB=0:MINB=0
2840 FOR N = FR% TO BK%
2850 IF WFMS%(N)=>MAXA THEN LET MAXA=WFMS%(N)
2860 IF WFMS%(N)=>MAXA THEN LET TMAXA=N
2870 IF WFMS%(N)<=MINA THEN LET MINA=WFMS%(N)
2880 NEXT N
2890 FOR N = FR% TO BK%
2900 IF WFME%(N)>MAXB THEN LET MAXB=WFME%(N)
2910 IF WFME%(N)=>MAXB THEN LET TMAXB=N
2920 IF WFME%(N)<MINB THEN LET MINB=WFME%(N)
2930 NEXT N
2940 '
2950 '  ..... go back in time; attempt to find baseline departure (bld)
2960 FINDA=0:FINDB=0
2970 FOR N=TMAXA TO 0 STEP -1
2980 IF FINDA=1 THEN GOTO 3010
2990 IF WFMS%(N)<=0 THEN LET BLDA=N
3000 IF WFMS%(N)<=0 THEN LET FINDA = 1
3010 IF FINDB=1 THEN GOTO 3040
3020 IF WFME%(N)<=0 THEN LET BLDB=N
3030 IF WFME%(N)<=0 THEN LET FINDB=1
3040 NEXT N
3050 ' ..... blda and bldb should be close to the baseline departures
3060 '
```

```
3070 ' ..... find the earlier in time
3080 IF BLDA<=BLDB THEN BLP=BLDA
3090 IF BLDB<=BLDA THEN BLP=BLDB
3100 '  BLP ( baseline departure point )
3110 LET BLP = (BLP/LE6%)*10
3120 LET BLP=BLP *1000: LET BLP=CINT(BLP):LET BLP=BLP/1000
3130 ' the peaks of the waveforms
3140 VMAX6 = (MAXA/64)*TF6*VS1
3150 VMAX8 = (MAXB/64)*TF8*VS2
3160 '
3170 REM ..... each  amplitude division for the 7912 is 64 bits
3180 LET MAXA = INT (MAXA / 64): LET MAXA = MAXA +1 : LET MAXA = MAXA * 64
3190 LET MAXB = INT (MAXB / 64): LET MAXB = MAXB +1 : LET MAXB = MAXB * 64
3200 LET PMAX = INT (MAXA*MAXB / 64): LET PMAX = PMAX +1 : LET PMAX =
PMAX * 64
3210 LET MINA = INT (MINA / 64):  LET MINA = MINA * 64
3220 LET MINB = INT (MINB / 64):  LET MINB = MINB * 64
3230 LET PMIN = INT (MINA*MINB / 64): LET PMIN = PMIN +1 : LET PMIN = PMIN * 64
3240 LET PMIN=PMIN*(-1)
3250 REM
3260 REM .... now have number of divisions ; one more either side, than needed
3270 RETURN
3280 STOP
3290 ' ..... shift.sub      ..... august 89 ..... jjl
3300 '        purpose : shift the time where power is calculated
3310 '
3320 REM
3330 LET FR%=FRT    ' the starting array point
3340 LET BK%=LE6%      ' the ending array point
3350 EX%=1
3360 GOTO 860 '  back to the graph routine
3370 STOP
3380 '   CURSOR ROUTINE.....
3390 YIN = WMIN
3400 XIN = FR%
3410 CM = WMAX/4
3420 FOR N = 1 TO CM
3430 PSET(XIN,YIN+N),1
3440 NEXT N
3450 FOR N = 1 TO CM
3460 PSET(XIN,YIN+N),0
3470 NEXT N
3480 ON KEY(13) GOSUB 3550
3490 ON KEY(12) GOSUB 3640
3500 ON KEY(10) GOSUB 4060
3510 ON KEY(1) GOSUB 4030
3520 KEY(1)ON:KEY (10)ON
3530 KEY(13)ON:KEY(12)ON
3540 GOTO 3420
3550 '       move cursor to the right
3560 FOR N = 1 TO CM   ' blank out last cursor
3570 PSET(XIN,YIN+N),0
```

```
3580 NEXT N
3590 XIN =XIN +5   ' move right
3600 T=T+(5*HSI)
3610 P = P+5:MOVE$="R"
3620 GOSUB 1680
3630 GOTO 3420
3640 '       move cursor to the left
3650 FOR N = 1 TO CM   ' blank out last cursor
3660 PSET(XIN,YIN+N),0
3670 NEXT N
3680 XIN =XIN -5   ' move left
3690 T=T-(5*HSI)
3700 P = P-5:MOVE$="L"
3710 GOSUB 1680
3720 GOTO 3420
3730 END
3740 ' ..... sub-routine to calculate power over time selected
3750 '
3760 '  (P) is the cursor position in the selected window
3770 '  (FR%) is the starting calculation point in the data array
3780 '  (FR% + P) is the stopping point in the data array
3790 '
3800 ' ..... first, calculate the average voltage (AV) and current (AI)
3810 '
3820 FOR N = FR% TO FR%+P
3830 LET AV=AV+(WFMS%(N)/64)*TF6*VS1
3840 LET AI=AI+(WFME%(N)/64)*TF8*VS2
3850 NEXT N
3860 ' ..... devide summed voltage and current by number of points
3870 LET AV = AV / P
3880 LET AI = AI / P
3890 '  and now, the average power
3900 '
3910 LET AP = AV * AI
3920 LOCATE 15,35:PRINT "                    "
3930 LOCATE 15,35:PRINT " V (ave) = ";AV
3940 LOCATE 16,35:PRINT "                    "
3950 LOCATE 16,35:PRINT " I (ave) = ";AI
3960 LOCATE 17,35:PRINT "                    "
3970 LOCATE 17,35:PRINT " P (ave) = ";AP
3980 LOCATE 18,35:PRINT "                    "
3990 LOCATE 18,35:PRINT " P * time = ";AP*HSI*P
4000 '
4010 RETURN
4020 END
4030 ' ..... just start over
4040 GOTO 10
4050 RETURN
4060 ' ..... back to menu
4070 CHAIN "menu79.ddt"
4080 RETURN
s
```

Appendix K.—Replacement of Digitizers

If it should become necessary to replace one of the digitizers, the software will require slight modification. For in-house (HDL) use there is a routine, transparent to the operator, resident on the hard disk in a directory named "GURU." This software (copyrighted by National Instruments, Inc.) must be used if either, or both, of the digitizers are replaced. It may only be done while the computer is under DOS control. To implement a change, use the following steps.

(1) From one of the DDT programs in IBM-BASICA, strike the Ctrl/Break keys and enter the word `SYSTEM`, then press the return key. The screen should show `C:/GURU`. If not, type `CD/GURU`. The `C:/GURU` response should appear.

(2) Type IBCONF and you should soon see the National Instruments logo on the screen. The program will scan a file on the hard disk (`GPIB.COM`) and prompt `Press any key to continue` when it is finished.

(3) The program is well documented and easy to follow. If you changed a digitizer, use the cursor keys (as instructed in the program) to highlight the name of the removed digitizer. Do **not** change this name.

(4) Press the F8 (Edit) key. The screen will then list eight attributes of this particular digitizer. It is only necessary to change the primary GPIB address. This must be a number between 0 and 30 which is selected (as shown) by incrementing either a right or left arrow key.

(5) With the address changed as required, select F9 to return to the Map. Change the other digitizer if necessary.

(6) When the changes are complete, strike the F9 (Exit) key. Answer '`Y`' for yes to the `SAVE changes?` query. The GPIB.COM file will then receive the new values.

(7) Before the changes may be implemented, the computer must be re-booted as is shown on the screen. This is done by pressing the Ctrl, Alt, and Del keys at the same time.

Appendix L.—Required Files

The programs discussed in this report will not work if certain files are not present in the operational directory on the hard disk. The names of these files are

(1) IBCONF.EXE (Commercial software; copy to root directory)

(2) CONFIG.SYS (tells the PC about GPIB.COM; root directory)

(3) GPIB.COM (created by INBCONF; root directory)

(4) BIB.M (in the working directory (WD)

(5) BIB728.M (WD)

(6) DAILY.CHK (WD)

(7) SHOT79.FIL (WD)

The actual programs are, of course, required. Their names are as follows: (1) MENU79.DDT, (2) TUTOR.DDT, (3) START.DDT, (4) GRAPH79.BW, (5) SHOT79.DDT, (6) NUMDSK79.DDT (7) COPYDAT.DDT, and (8) POWER79.DDT. Other files needed are PROBE79.DDT, NUMBERS.DSK, and SHOT79.FIL.

To automate the loading of the MENU program, the AUTOEXEC.BAT routine in the root directory should be modified (DOS-EDLIN process) so that the next to last line changes directories to where these programs and files are stored (e.g., CD/GURU), and the last line reads "BASICA MENU79.DDT."

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